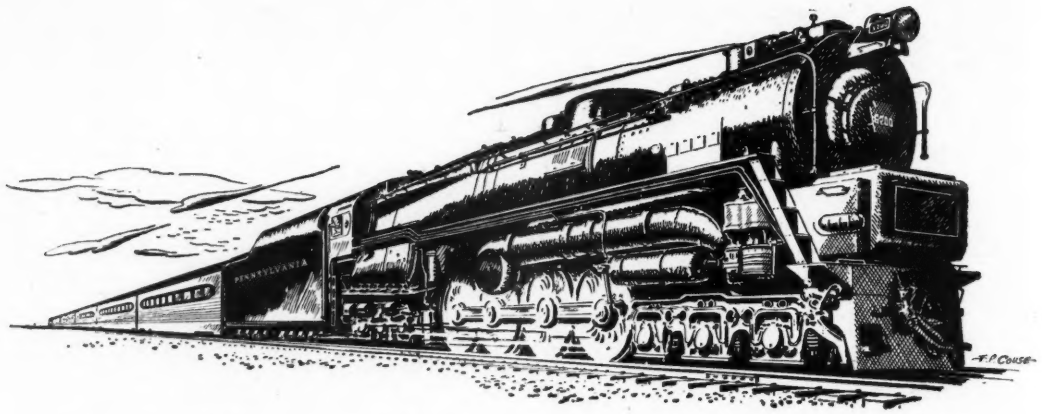
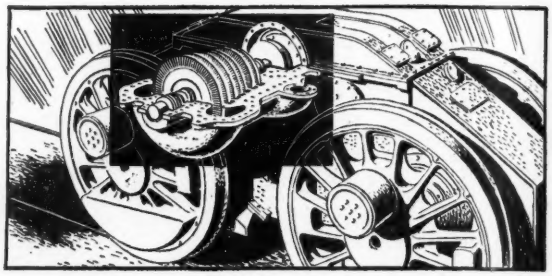
THE CORNELL ENGINEER

LLEGE OF ENGINEERING · CORNELL UNIVERSITY

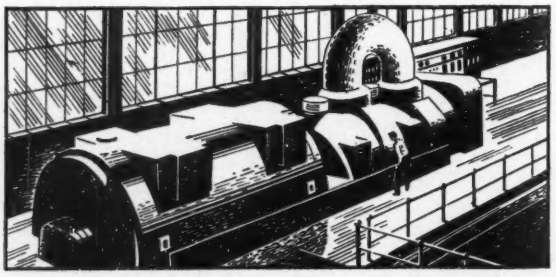


This Newest Locomotive
is Powered Like a Battleship

LONG AGO successfully developed by Westinghouse for ocean vessels, the *steam turbine* has now been harnessed as a brand new type of smooth, efficient motive power for modern railroad locomotives.



THE WESTINGHOUSE steam turbine in the Pennsylvania Railroad's new direct-drive locomotive is *no bigger* than a household electric refrigerator—yet it will haul long passenger trains with ease.



THE POWER-PACKED locomotive turbine is a descendant of giant Westinghouse turbines which generate much of the electricity used today. The great expansion of electric power began with these turbines.

THE VELVETY FLOW of power from this 6,900 horsepower *steam turbine* locomotive will make trains run with extra smoothness and is a major contribution to finer transportation for the future.

THE RAILROADS are developing a dazzling new kind of transportation for the future. The latest and most dramatic improvement is *steam turbine* power, which gives the Iron Horse "new lungs."

To help produce this new locomotive, the Pennsylvania Railroad, a long-time pioneer in transportation improvements, turned to Westinghouse and the Baldwin Locomotive Works. Working as a team, these companies have produced this latest in a great line of steam locomotives—descended from "Old Ironsides," built by Matthias Baldwin in 1832. *Westinghouse Electric & Manufacturing Company, Pittsburgh 30, Pennsylvania.*

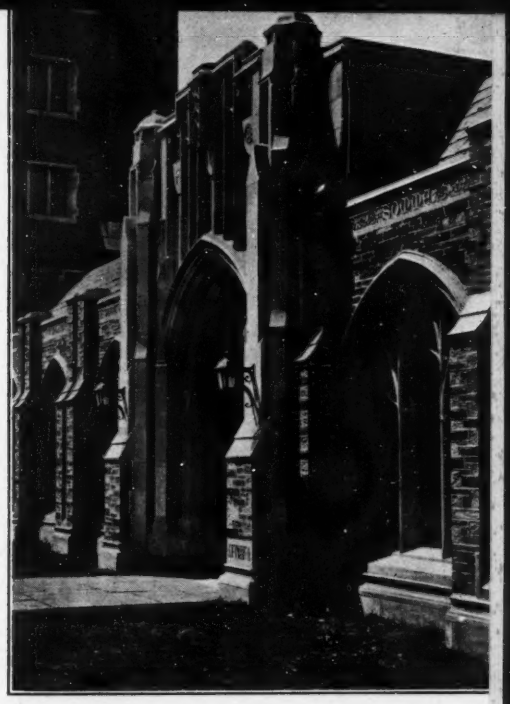
Westinghouse
PLANTS IN 25 CITIES OFFICES EVERYWHERE

Westinghouse presents:* JOHN CHARLES THOMAS—*Sunday 2:30 pm, EWT, NBC

The CORNELL ENGINEER

1945

Volume 10 Number 6



CONTENTS

Above is a view of the West Avenue entrance to War Memorial.

★

COVER

Spring comes to the Campus —the Library Tower as seen from Campus Road below Willard Straight Hall.

★

FRONTIS

Boulder Dam, designed to supply 1,317,500 kilowatts to cities, shipyards, and other industries in the Southwest, has been vital to war-production in that region.

—Courtesy General Electric

Member of The Engineering College Magazines Associated

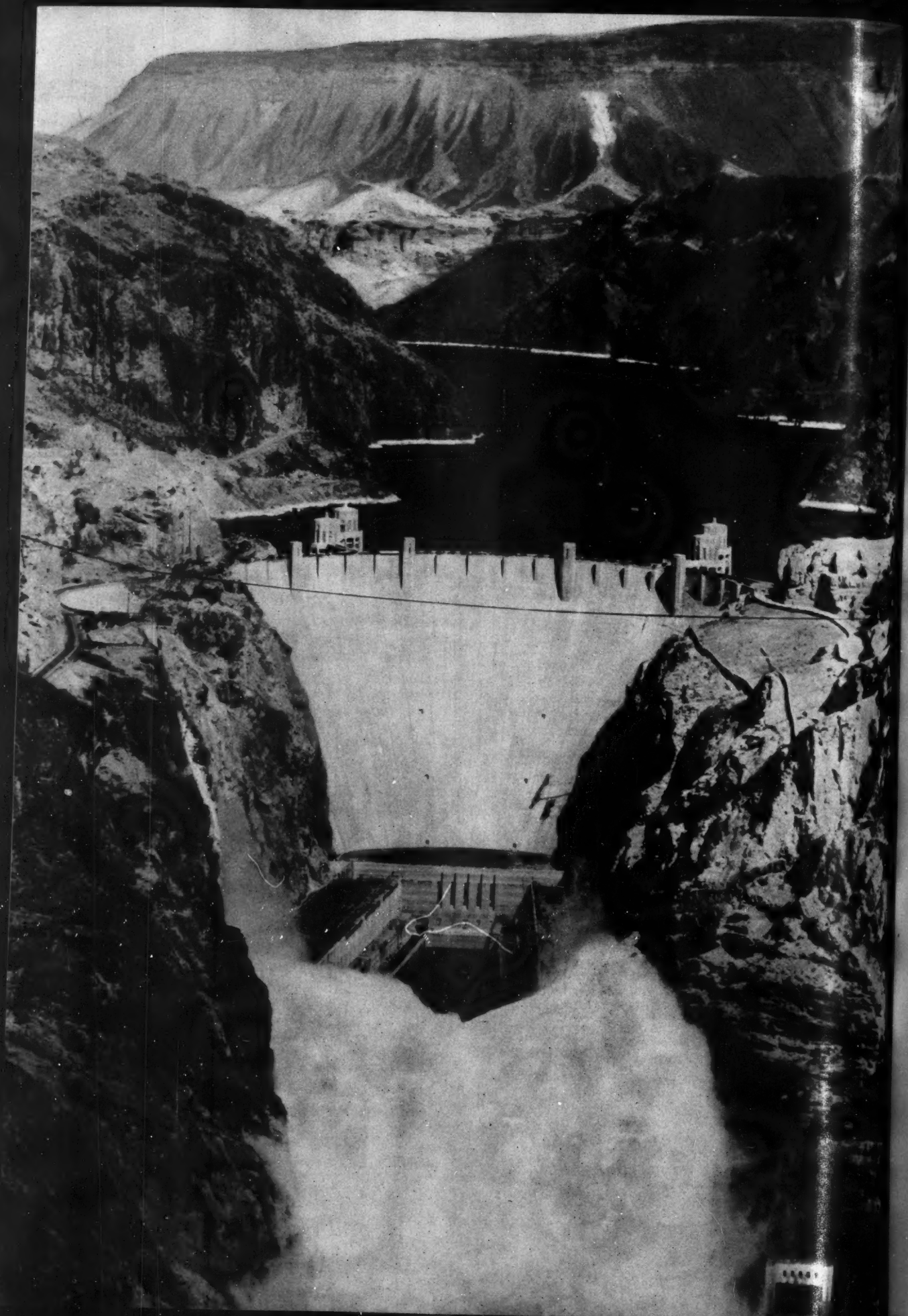
Chairman, John W. Ramsey, Tennessee Eastman Corporation, Oak Ridge, Tennessee
Advertising Representative, Littell-Murray-Barnhill, Inc.,
101 Park Ave., New York and 605 N. Michigan Ave., Chicago

Arkansas Engineer
Colorado Engineer
Cornell Engineer
Illinois Technograph
Iowa Engineer
Iowa Transit
Kansas Engineer
Kansas State Engineer
Marquette Engineer
Michigan Technic
Minnesota Techno-Log
Missouri Shamrock
Nebaska Blue Print
New York Univ. Quadrangle
Ohio State Engineer
Oklahoma State Engineer
Oregon State Technical Record
Pennsylvania Triangle
Purdue Engineer
Rose Technic
Tech Engineering News
Wayne Engineer
Wisconsin Engineer

Published monthly—October to May—by the **Cornell Engineer, Inc.**, Lincoln Hall, Ithaca, N. Y. Edited by the undegraduates of the College of Engineering, Cornell University. Entered as second class matter at the Post Office at Ithaca, N. Y., under Section 103, Act of October 3, 1917.

Subscription per year: regular $1.50; with membership in the Cornell Society of Engineers $2.00 (See President's page); student $1.00: single copy $.20.

This issue: March, 1945.



FOR
yea
Dome
activity
ant ele
gram.
fense C
its pur
tional
in ind
training
The
atory
series o
ordnanc
Nine m
in this
with la
training
tion of
gages, a
sub-asse
facture.
with di
spection
nance ar
was de
teachers
on inspe

Use of

Wide
monogra
oped by
Ordnanc
the train
in the
country,
engineeri
Laborato
in the pl
The insp
also used

INSTRUCTIONAL MATERIAL FOR TRAINING PROGRAMS

By PROFESSOR LYNN A. EMERSON

Director of the National Defense Curriculum Laboratory

FOR the past three and one-half years the basement of Sibley Dome has housed a phase of war activity which has been an important element in the war training program. It is called the National Defense Curriculum Laboratory, and its purpose is to develop instructional materials primarily for use in industrial and technical war training classes.

The initial activity of the Laboratory was the development of a series of monographs dealing with ordnance and aircraft inspection. Nine monographs were completed in this series, six of them dealing with laboratory courses for the training of personnel in the inspection of machined parts, tools and gages, and inspection of parts and sub-assemblies in aircraft manufacture. Two monographs dealt with directions for setting up inspection training programs, in ordnance and aircraft respectively. One was developed which provided teachers with outlines for shop talks on inspection.

Use of Monographs

Wide use was made of these monographs in the program developed by the Office of the Chief of Ordnance, Washington, D. C., for the training of ordnance inspectors in the vocational schools in the country, and the Director of the engineering colleges throughout the Laboratory was requested to assist in the planning of these programs. The inspection monographs were also used, to a lesser extent, in inspection training programs for the Navy.

Electrical Monographs

Following the completion of the series of monographs on inspection, the Laboratory undertook the development of a series in the electrical field. This series included several monographs dealing with basic electrical principles, and others dealing with the more advanced aspects such as motor control and industrial electronics. Nine different monographs have been developed to date in this series.

When interest began to grow with respect to the use of gliders in the war effort, work was started on a monograph dealing with the fundamentals of wood-fabric glider construction. A training program for teachers of glider construction was in operation at Cornell at that time, and the monograph was developed in close cooperation with this program.

For War Classes

Two monographs were developed in the Laboratory for the purpose of improving the instruction in war training classes. One of these was an illustrated monograph dealing with the various aspects of the teaching job. Another dealt with

THE AUTHOR

After his graduation from the U. of Minnesota as an E.E. in 1911, Professor Lynn A. Emerson engaged in graduate work in education at the U. of Chicago and later at N. Y. U., where he received his Ph.D. in 1932. He gained considerable experience in industry, in teaching, and in education, becoming Assistant Superintendent of Schools in Yonkers in 1936. In 1938 he came to Cornell as Professor of Industrial Education. He was appointed Assistant Dean of the College of Engineering last September.

Preceding his appointment as Director of the National Defense Curriculum Laboratory in Ithaca, Dr. Emerson engaged in work and consultation in technical education for the U. S. Office of Education and the Illinois Legislative Commission.

Prof. Emerson

the problems encountered in the supervision of war training programs.

An important aspect of the work of the Laboratory has been its cooperation with Air Service Command in the development of its training program for the air depots. The Director of the Laboratory served as consultant to the training staff at Air Service Command Headquarters, and the Laboratory developed two monographs especially designed for the training program in the army air depots. One of these dealt with the reading of aircraft drawings; the second dealt with instructor training.

Recently the Laboratory has completed a monograph on the fundamentals of pressure and temperature instruments. A second monograph of more advanced type, covering many applications of instruments to process control, is now under way.

Procedure

The procedure in the development of a monograph varies somewhat in the different fields with which the Laboratory has been concerned, but in general, it follows the same steps:

1. Assembly of needed working materials, largely books and other reference materials.
2. Analysis of the field to be covered.
3. Selection of the subjects to be included.
4. Organization of the content into suitable units or groups.
5. Writing the copy for each unit.
6. Illustrating the copy, with drawings or photographs.
7. Editing and revising the copy.
8. Preparation of the copy for printing.

Assemblage

Fields for which monographs are to be prepared are chosen in the light of needs of the war training program, and the personnel available. Technical experts in the selected field are assembled, usually on a part-time basis. Under the direction of a trained supervisor, these experts are given some instruction in the procedures and techniques used in the Laboratory. In some cases the principles underlying the instructional procedures of war training classes are explained, and the basic principles of learning and of teaching are reviewed. Under the leadership of a trained analyst, the field of the monograph is analyzed, usually through group discussion. From the resulting analysis certain topics are selected to be included in the monograph, and these topics are arranged in proper instructional order. Then each technical expert is assigned certain portions to write, usually on the basis of his interest and experience. Rough drafts are usually written in longhand, then typed and presented to the whole group for discussion. Through this discussion all members of the group come to a somewhat uniform style of writing, and content is subjected to critical examination with respect to technical accuracy, form, and the like. The copy progresses through successive revisions, and is finally ready for master copy preparation. The monographs are printed by the offset process, and when the master copy leaves the Laboratory it is ready for photographing.

The summer session at Cornell found these men doing preliminary work on electrical monographs.

Problems Arising

Many problems arise in the development of a monograph. Standardization of symbols and nomenclature has presented many difficulties, especially in certain fields where the symbols have not been approved nationally by any standardizing agency. No two technical experts have the same style of writing, and this requires considerable editing to make the overall effect a desirable one. Illustrations that are clear, direct and forceful are often hard to get, for many artists lack the technical knowledge necessary to produce drawings which are technically correct. Frequently the manufacturer of equipment is able to furnish drawings and photographs, but these often require modification to make them fit the written copy. Much care is needed in the editing to insure clean copy which gets the message to the reader in a clear unmistakable fashion.

The equipment of the Laboratory includes a small library, drafting equipment, Ozalid machine, vari-

(Continued on page 40)

Monographs on radio, farm tractors and glider construction are being completed in the curriculum laboratory.

CONSTRUCTING THE IRAQ PIPELINE

By HERBERT S. AUSTIN, C.E. '07

FATE—he was to remember in the after-years—gave him definite warning. 'In this moment,' said Fate, 'life alters'."

With the words of this quotation ringing in my ears, it was my privilege in the latter part of 1930 to cross the Atlantic for the first time and, in December, to leave London in an Imperial Airways plane for the Near East. During the course of previous years, a great association of oil interests had been formed for the development of oil resources in the vicinity of Kirkuk, about 200 miles north of Baghdad. This association, known as the Iraq Petroleum Company, Limited, with partners representing English, French, Dutch and American interests, is incorporated and domiciled in Great Britain. The development of these oil fields had at this time reached a stage indicating available quantities of oil sufficient for the building of a pipe line outlet, and it was with instructions to investigate routes for such an outlet that we traveled from London, via Marseilles, and thence to Haifa, Palestine, which latter place eventually became general headquarters for the construction of the Iraq pipe line.

Still a Thrill

There are few thrills left in this life, but believe me, it is a thrill to cross to the eastern shore of the Mediterranean, fly a distance of some 45 miles inland, circle Lake Tiberias, settle upon its waters and taxi to shore—to the shore of the Sea of Galilee. Alternatively, one may arrive by boat at Haifa, Beirut or Tripoli. Whatever the means of transportation, one steps ashore along the eastern Mediterranean coast and travels inland, crossing the gently rising coastal plain from one to five miles in width, then a stretch of rolling country, after which one goes up a steeper rise until a distance of from 100 to 125 miles east of the coast. Such is the character of the entire eastern Mediterranean coast so far as our pipe line was concerned—the narrow coastal plains section and then a sudden rise to an elevation on the southern line of 3400 feet above sea level.

THE AUTHOR

Herbert Sidney Austin, C.E. '07, was engaged in subway construction and structural design for a short time after graduation. He returned to Cornell to teach for a term, and then entered the pipeline industry in 1911, rising to chief engineer of the Oklahoma Pipeline Company in four years. From 1921 until 1930 he held positions as inter-refinery pipeline superintendent for Standard Oil, President of Tuscarora Oil Co., and President of Ajax Pipeline Company. He was loaned by Standard Oil to the Iraq Petroleum Company during the construction and early operation of the pipeline described in this article, returning in 1935 to Standard Oil as coordinator of their pipeline systems. Austin was in London in 1939 representing American interests in the Iraq Petroleum Company. After retiring in 1940 he was consulted on Army and Navy projects in Hawaii, Iceland, Iran, and Aruba.

Austin has had honors conferred on him by the King of Iraq and the President of France.

To the Oil Fields

From this high point near the western railhead we descend gently for 350 miles across the desert to the Euphrates River. The elevation here is about 450 feet and we are still 100 miles from the eastern railhead, to which supplies are brought from the north end of the Persian Gulf. Leaving this point on the Euphrates, called Haditha, we gradually rise in elevation for a distance of approximately 150 miles to an elevation of 1,000 feet and reach the oil fields located near Kirkuk—our furthest point east, where we are over against Persia and not far from Russia.

A Clay Desert

We are 618 miles over the pipe line route from Haifa. We have learned that, contrary to the popular idea, there is very little sand in our portion of the desert. We have found a hard surface upon which it is generally possible to drive at a high rate of speed in any direction—a clay desert. We have, however, on our journey encountered some of the annual seven inches of rainfall in this part of the world and we have been stuck in the resulting mud. We have had to take our baggage truck apart in order to cross one of the rivers; we have been lost in the middle of the desert and have had to navigate our way out; we have eaten our Christmas dinner in the midst of this barren waste. We have learned a profound

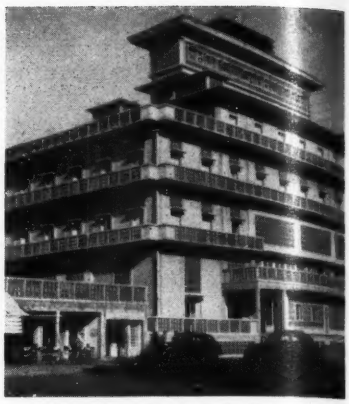
respect for it.

Its desolation did then, and does now, command the sincere respect of those of us who were engaged upon the pipe line construction. We understood why the Arab respects and fears this waste which has been a barrier for so many centuries and about which from his childhood he has heard all the lore. In this barren country the town Arab undoubtedly feels as far, in fact farther, from his home when 100 miles distant, than an European feels who is 6,000 miles from his home in other parts of the world.

It may well be illustrated by telling you this story. One of the first operations in our work was the putting out of a party in order to explore the water possibilities. Their drilling rig was set up at the edge of the lava country about 150 miles back from the Mediterranean coast. The man in charge of the party allowed a native driver with three or four native laborers to leave camp one afternoon for the purpose of obtaining a fresh meat supply through the shooting of gazelles. Because of the isolation, his being a misfit, or possibly due to some mental disturbance, the driver, in a fit of rage, turned the men out of the car, forcing them to walk some 10 to 12 miles back to camp. He did this on the plea that there was no gasoline nor water in the car. After letting them get a short distance away, he took out across the desert. The second car at the camp had been sent to Rutbah for camp supplies and had not returned when the men reached camp. Pursuit without a car was useless. Night fell and a lantern was hung at the top of the drilling rig. Shortly after dark the headlamps of the automobile were seen careening back and forth across the desert, and at 10 o'clock they were seen for the last time. When the other car arrived in camp about 2 o'clock in the morning, it immediately set out in search. Shortly before daybreak they came upon the abandoned car which was then indeed out of both gasoline and water. It was at the edge of the lava country. The man's tracks were followed into the lava and then it became impossible to trace them further. Two airplanes flew low over the territory during that day and the next. To this day no trace has been found of the poor driver.

Kirkuk

During our pause at Kirkuk we travel by rail to Baghdad, that city of the old caliphs and the forty thieves, many of whose latter descendants still reside there. While here at Kirkuk we must also look at the oil fields and examine carefully the surrounding country for a suitable site upon which to locate our initial pumping station. In the meantime, rest for the men, examination of the motor cars for defects, and the repair of them has been accomplished.



Hotel St. Georges in Beirut

Over the same route we have traveled, we retrace our steps west from Kirkuk to the Euphrates River. Here the pipe line divides into two branches, and we take the northern one to the coast. The general topographic characteristics of the northern branch are similar to those noted on the southern. The high point on this branch, however, reaches an elevation of 2500 feet above sea level. It is 534 miles from Kirkuk to Tripoli. The laying of a double line in some locations gave us 1180 miles of pipe in the total line, this pipe weighing 119,000 tons. The line, buried underground, was protected against corrosion through the application of a priming paint and a coat of asphalt, and then a spiral wrapping of impregnated asbestos felt paper —"the longest package in the world"—one writer called it.

Following the pipe line is a telegraph and a telephone line. In the construction of this, holes were dug for the setting of 27,000 poles. These figures given you are actual construction figures. In 1930 they did not even exist as such on paper. As they were developed bit by bit in the later surveys and designs, sheer logic alone kept them from becoming appalling.

Sheet of Lava

A unique and startling area approximately 250 miles from north to south and 1110 miles from east to west lies athwart the southern route. Geological evidence tells us this was originally a solid sheet of lava. Many evidences of the old volcanic cones still remain, and when flying over it its appearance at the northern end is still stained and tortured like the bottom of a

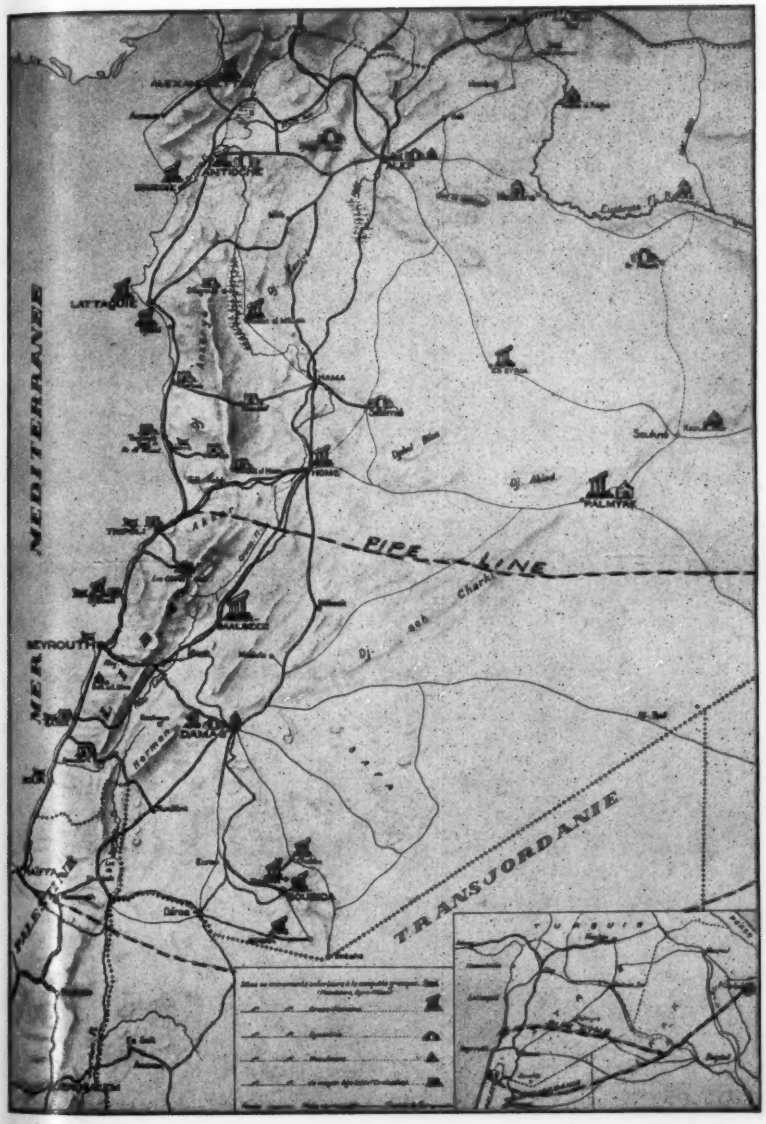
Beirut, one of the gates to Asia, is spread out in terrace fashion on the hills of a cape.

crucible. At the southern end, this lava sheet has been broken into small fragments—fragments lying so close together that throughout the entire area it is difficult for either camel or man to pick his way.

From the western edge of this lava country the pipe line sweeps down into that fissure in the earth —the Jordan Valley—and crosses the river five miles south of the sea of Galilee. It was across this corridor of time that the pipe line gangs during the heat of July and August laid the pipe line—across the corridor into which, were the Mediterranean admitted, the gangs would have been working 800 feet below the surface of the water. This elevation makes the Jordan crossing one of the most unique oil pipe lines in the world.

As I have told you before, the highest elevation on the southern line is 3400 feet above sea level. On the east side of the Jordan within a distance of 18 miles, down the hills of Moab, the line drops from an elevation of 2600 feet above to this point 800 feet below sea level. So steep is this downward slope that in order to prevent a destructive velocity of flow from developing, the usual run of 12″ diameter pipe was reduced to 8 inches for a distance of nine miles in its precipitous descent. Thus is provided a safe working pressure at the bottom of the valley, and in order to be doubly safe, a pressure relief station fully equipped with tanks, pumps, etc. is located upon its floor.

Route of the Iraq pipeline



There are many other strange and impossible things to a westerner. The temperatures on the desert in the summer time are very high. They reach during August and the first part of September 120 to 130°F. in the shade—and there is no shade. The sun temperature is 170° or higher—so hot that it is impossible to pick up a wooden pick handle with the bare hand without raising a blister. That is what happened on the pipe line construction. The men worked from daylight until about 10 AM and then, "after the heat of the noonday" they worked from three or four o'clock in the afternoon until seven or eight at night. The nights are always cool, showing how wisely nature compensates, and these cool nights do allow a good night's rest.

But we are here to build a pipe line and what are we to do? What must we do to solve our problems in the handling and transporting of men and materials and to adequately and safely feed, maintain and look after the men engaged upon the work? The concession leaves us barely four years in which to complete the job and get oil to the coast. We must work over a right-of-way 1080 miles in length; over a desert about which even the best available knowledge tells us surprisingly little.

As In An Army

As in the advance of an army, our forces must not get too far ahead of supplies and communication lines. We must have efficient systems and management must always be within direct and easy contact with the front lines. Telegraph lines, telephone lines, automobiles are needed, and we must have airplanes—for there will be men and then more men employed, over whom a guardian eye must be ever alert.

But it is a desert, and water is a precious commodity—how precious those of you, who in their lives have lacked it, know. Hence our first concern was the organization of a water research department. Small units were organized and these pioneers, camped finally at each pumping station site, drilled shallow wells. The results were more gratifying than was expected, and all the later construction oper-

(Continued on page 28)

THE CERAMIC INDUSTRY TODAY

By RODERICK W. PEARSON, ChemE '47

THE ceramic industry includes all industries manufacturing silicate ware, all kinds of clay products such as glasses, enamels, cements, and mortars. It is one of the oldest industries in the world, having started with mud dishes at the birth of humanity, and grown until it is now one of the larger industries in the United States, with 3,600 plants employing 260,000 people and using 56,000,000 tons of raw material annually. Although it is one of the few billion dollar industries in this country it is comparatively little known because most of its products go into industry and hence are used largely for making other things.

Clay is a term which means a tenacious earthy substance, usually formed of a mixture of silica and alumina in different proportions and colors. Clays have been formed through the breaking up of rocks (usually aluminous) by natural forces, such as rain, snow, freezing and thawing. Sometimes they are found by their mother rocks from which they were formed, and on other occasions they are found at considerable distances from their place of creation. These latter could have been carried in suspension in water for long distances, in which case they are known as transported clays, or they could have been carried a long way from the mother rock by glacier movements. These last are known as boulder or till. Those clays which are found by their mother rocks are known as residual clays. Because of this transportation and the fact that many clays are mixtures of various different types, one clay from one section of the country usually is extremely different from a clay from another portion of the country. Pure clay, however, is a hydrated silica of aluminum having the formula $Al_2 O_3 . 2 Si O_2 . 2 H_2 0$ and is known technically as kaolin. All clays have this as a basis, but are designated by many different names such as ball, pottery, pipe, stoneware, fire, flint, and so on. The difference in these clays is the amount of clay base they contain in relation to the amount of impurities present.

Sending Poden City pottery to be glazed. The plates will emerge with a glass-like finish. *—Courtesy of Ceramic Industry*

Plastic Property

When clay is wet it is plastic and can be molded by hand or machine into any shape desired, and it will preserve that form until it is dry enough to be made permanently hard by fire. This plastic property of clay is what makes it so important and valuable. However, in order to make clayware there is a little more difficulty involved in the procedure than just digging it out of the ground, forming and then firing it. If it is worked up as soon as it is brought from the ground it usually cracks. In order to prevent this it is customary to expose the clay to the weather some time before manufacturing it into wares. One method of doing this is by letting the clay be exposed to rain, snow, freezing or thawing for a definite period of time. The rain and snow are commonly known as acid carriers, although the snow acts more vigorously than the rain since it often lies for long lengths of time on the clay, and as it melts in the spring it permeates more thoroughly and uniformly through the clay and dissolves more of the impurities. By getting rid of the alkaline earths and iron and sulfur compounds, vegetable substances and other organic compounds which acted as impurities, the clay becomes purer, the proportion of the colloid substance is increased, and the clay becomes more plastic. An-

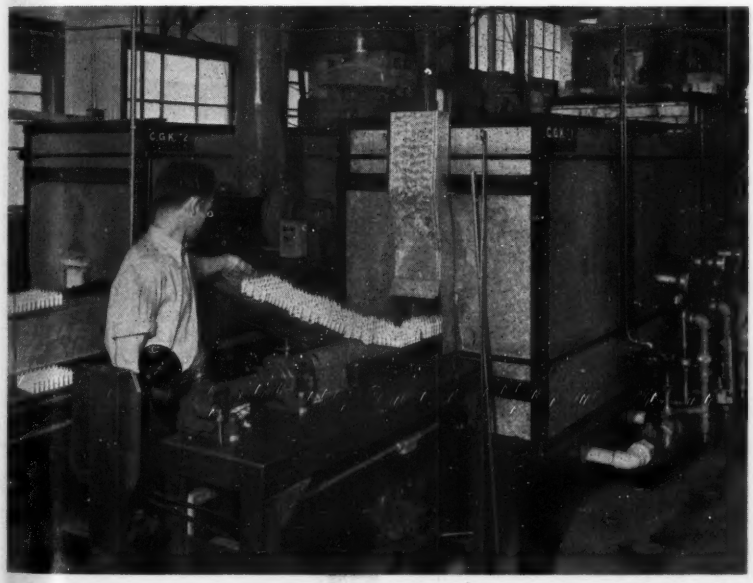
other method of accomplishing the same thing is by the "soaking process." In this system the clay is finely ground, and is placed in a pit and allowed to remain covered with water for from two to three days.

Omitting the preceding steps means failure, for, if the fired products are made from improperly treated clay, they will crack. Cleanliness and exactness are very essential to the success of the work and the person in charge of such work should have every step of the process put under his control and should see that everything is done according to his instructions.

After the clay has been prepared to a workable condition and has been weathered or soaked, it is shaped and allowed to dry.

Shrinkage

If the water which was present when the clay was wet is dried out, the substance will shrink, the amount of shrinkage depending on the amount of water that was used in working the clay, and the amount that evaporates in drying. After the clay has been molded and dried it feels absolutely dry and seems absolutely lacking in moisture. There is still some moisture left, however, and this is removed through firing in the kiln. A kiln is a large stove or furnace for hardening, burning, or drying anything.

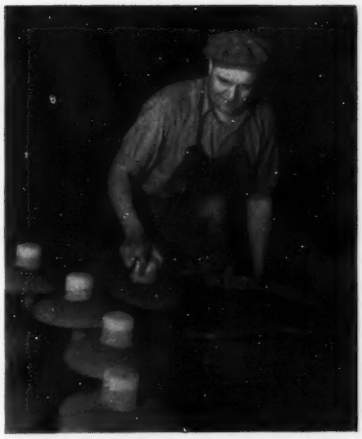


—Courtesy of Ceramic Industry

A step in the production of Champion spark plugs.

In setting objects in the kiln one must be careful to leave enough space for the free passage of the smoke and flames among the articles, so that a good draft and an even distribution of heat to all parts of the kiln is achieved. The burning itself is divided into three stages known as dehydration, oxidation, and vitrification. The first stage is the one in which the moisture is driven out of the articles being fired, and the temperature during this portion of the firing should not exceed 212 degrees Fahrenheit or the surface pores will be closed, and the continued heating of the enclosed moisture would turn it to steam and the object would burst. This stage takes from two to four days. After the burner has made sure that all the moisture present has been driven off, the heat is raised to 400 degrees Centigrade, slowly, to prevent cracking of the objects. The impurities present in the object being heated are driven off in the second process, which is called oxidation; and then the third stage begins. This is vitrification and consists of changing a substance by heat or fusion into glass or a glassy substance. The amount of heat required to accomplish this varies with the substances involved.

Once the vitrification is over and the firing has ceased, the process of cooling begins. It is just as essential to have complete control over cooling as it is over firing, especially in the manufacture of porcelain, terra cotta, stoneware, bricks and glass. As the temperature descends to red heat rapid cooling is necessary to prevent too great a crystallization of the molten material. But when the temperature has reached red heat, the cooling must proceed slowly or the ware will be brittle.



—Courtesy of Westinghouse

Hand-dipping Westinghouse insulators in a ceramic plant.

Result of Annealing

The result of this cooling or annealing process is the orderly distribution of the molecules within the substance, thereby avoiding molecular strain. If the annealing part of the cooling process were done extremely rapidly the molecules on the outside of the substance would solidify immediately, thus preventing the inside molecules from arranging themselves properly. This in turn causes internal stress, and if the hard surface of the substance is damaged, internal cracks will occur and the product will not be sound.

A few of the more basic types of clay products are refractory wares, chemical stoneware and sewer pipes.

Refractory wares are those that possess the property of withstanding a high temperature combined with load and pressure. Highly refractory ware is manufactured from fire clay. When it is to be used for high quality refractories, flint clay or bauxite is mixed with the fire clay. Crucibles or refractory ware must hold up under the pressure of their own weight and that of their

(Continued on page 30)

Engineering At Cornell

5. An Experiment in Instruction

By PROF. LOUIS L. OTTO, M.M.E. '43

Photographs by R. C. Reese, V-12

DURING the spring term of 1944 the Mechanical Laboratory Department was approached by several students who wished to take an additional course in internal combustion engines. They had all been through a three hour recitation course devoted to the study of engines, and had in addition performed several "Mech Lab" experiments dealing with various phases of engine operation, but they desired a course in which they could actually tear down and reassemble a representative engine to see and feel in three dimensions the various parts which constitute a modern internal combustion engine. They had no complaint to make about their previous courses in this field, but felt that they personally had not obtained a sufficiently clear conception of the functions and relations of various engine components through the study of textbook diagrams and descriptions.

When the number of inquiries indicated that there might be a sufficient number of students interested to warrant giving a course of the type desired, the Mechanical Laboratory Department in conjunction with Professor G. R. Hanselman, the class adviser for all V-12 students taking the Mechanical Engineering curriculum, called a meeting of interested students and obtained definite assurance from a group of them that they would take the course if it were offered.

After a conference between the author and Professor C. O. Mackey, Head of the Mechanical Laboratory Department, it was decided to obtain the necessary personnel and equipment and to offer the course for a limited number of terms. Among the reasons motivating this decision were the obvious demand for the course, and the opportunity which it offered to try out in advance of their scheduled appearance the new experiments and demonstrations which were to be developed to expand the laboratory instruction in internal combustion engines. Several of the curricula in the V-12 program require that during the seventh or eighth terms the students take a five (credit) hour course in internal combustion engines. This course will consist of three one-hour lecture recitation periods per week, coordinated with two three-hour laboratory periods per week. The increase in laboratory time will allow an expansion and improvement in the instruction on internal combustion engines over and above what it has previously been possible to give. The members of the proposed course could be of great aid in obtaining student reaction to the new features of this expanded program as they were developed. This new course is to begin in July 1945, and problems of space, personnel, and equipment indicated that it would probably be best to terminate the experimental course at that time.

Space and Equipment

The problems of equipment and space were overcome by buying, borrowing, and improvising. To obtain immediately the necessary number of engines the department approached the local office of the Engineering, Science, and Manage-

THE AUTHOR

Prof. Louis L. Otto graduated from the Sibley School of Mechanical Engineering at Cornell in 1933, and he continued in his graduate work to receive his M.M.E. there in 1943. His graduate work consisted of the Development of an Automotive Chasis Dynometer and the Investigation of the Use of Propane as an Engine Fuel. He received his practical experience in the U. S. Gypsum Co., acting as foreman, and the Kaustine Co. Inc., manufacturers of Sewage Disposal Equipment and Welded Steel Articles, where he acted as Chief Engineer.

As an undergraduate at Cornell, he was a member of the Sigma Alpha Epsilon fraternity, and was a member of the following honoraries: Tau Beta Pi, Phi Kappa Phi, Sigma Xi, Atmos, and Quill and Dagger.

Prof. Otto

Mr. Otto is now Assistant Professor of Automotive Engines and Mechanical Laboratory at Cornell.

ment War Training program, and through their kindness was able to borrow enough suitable engines to complement those available in the department laboratories. When the University started the Diesel Engine school for the Navy, a large number of used car and truck engines were obtained on short notice from various sources and were used in acquainting the students with proper overhaul practices before turning them loose on more expensive and less easily available diesel engines. A change in the curriculum of the Navy Diesel course had left these engines available. They were of many different makes and styles. Their year of origin varied from the late nineteen thirties to the middle nineteen twenties, although the age of one engine was implied by an inscription on its side to the effect that "George Washington worked on this engine." Their condition varied from the ridiculous to the sublime. From this group were selected several engines which seemed to be reasonably complete and in fair mechanical condition. There was sufficient variety available to obtain at least two each of four, six, and eight cylinder types. Also represented were both downdraft and updraft carburetion, single and double tube carburetors of many different styles, single ignition and duel ignition, battery ignition and magneto ignition, overhead valve combustion chambers and L-head combustion chambers.

This variety of engine types was obtained intentionally, since it gave to the students a three dimensional operating illustration of the various types of engine construction. The fact that the mechanical condition of the engines was not as good as it might have been was considered as an advantage rather than a disadvantage. A new engine in perfect mechanical condition would be a good illustration of what an engine should look like, but nothing so forcefully brings out the effects of high temperature, high speed, poor oil, and the other abuses to which an operating engine is subjected as an engine which has had to undergo these trials and bears visible evidence of them. A black, tenacious coating of oil sludge worked into the hands is a graphic reminder of the condition which can be produced in an engine. Visual inspection of a bearing with fully 50% of its babbitt lining lost due to fatigue failure is more convincing than an hour's lecture on the evils of over loading and undercooling bearings. The time and work necessary to recondition a pitted and burned valve produces a lasting impression of the evils of improper valve operation.

Marine V-12, Ken Campbell, working on the 4-cylinder Mack truck engine.

Other material was not obtained so easily. Tools at that time were scarce and hard to obtain. By scouring the local garage equipment dealers, the auto supply stores, and the mail order houses a sufficient number of wrenches, etc., was finally obtained to start the course at the time expected. Some items dribbled in throughout the first term of operation. Some took a full six months to arrive, and some items which are needed have never been received. But by borrowing some items from the department shops and personnel, and by improvising substitutes for others the course was carried through much as planned.

Working Space

The problem of suitable space was solved satisfactorily by utilizing a portion of the second floor of the West Mechanical Laboratory. A lecture and recitation room was available immediately adjacent to the working area, and a former dark room was available for use as a combination tool and wash room, and the working area available was sufficiently isolated from the more frequently travelled hallways to avoid interruption between classes.

The course was planned on the basis of two three-hour laboratory periods per week. Each three hour period was divided into a lecture and demonstration period lasting from half an hour to an hour and a half, with the balance of the three hours devoted to work upon the engines. The lectures generally covered one component of the engine only, with the sequence of topics so chosen as to anticipate as much as was possible the stage of disassembly which the students would reach on that day. During the disassembly period it was rather difficult to keep up with the progress of the work, but after the initial rush it was usually possible to anticipate and keep ahead of approaching phases. The initial period in the course was reserved for a discussion and illustration of hand tools and their proper use. Very few of the students had had any previous experience in the proper use of hand tools, and many of them were not well informed on the terminology of tools or on the types available. Experience has shown that the lecture was only the initial step towards the development of correct procedures, since it was necessary to maintain constant vigilance throughout the course to catch and prevent the use of methods which would be detrimental to the engines or dangerous to the operator. So far the damage to personnel has been limited to several skinned knuckles, although the equipment

Nehmet Incikaya, a Turkish grad student, repairing an 8-cylinder Packard engine.

(Continued on page 36)

ENGINEER

Miki

Marguerite Haven, ME '45

At the mass meeting of engineers on the day after registration in the fall of 1942, three bewildered girls sat among the many men who had enrolled in engineering. One of these girls was Miki Haven, prospective mechanical engineer.

Miki has never given a fancier answer to the question of why she chose engineering as a vocation than, "I like it." She has never regretted taking a technical course —even though she has had to struggle over some problems in Heat Power and Strength of Materials while the other girls in her house were playing bridge or some such thing in their spare time. Miki says, "The satisfaction of finally finding the solution to a problem is a marvelous feeling which can never be felt by those who do nothing but memorize subject matter for their courses." Her father told her that if she remembered nothing that she had learned in college but had gained the faculty to think, her eight terms would be worthwhile. Miki says he was right.

She refused to break tradition by telling her age. Her home base has been in Scotia, New York ("You know, across the Mohawk River from Schenectady and Dad's General Electric") with most summers spent at Lake George and four winters in Fort Lauderdale, Florida.

High school was fun for Miki. Her accomplishments included being a majorette for a gym exhibit and community chest drive, playing a small part in a Dramatic Club play, and learning to play poker with the first five on the basketball team. However, she had to settle down when she came to Cornell. Her Freshman year was spent under the illusion that she would bust out, but in spite of courses in Machine Shop, she slowly gained confidence in her ability. During one final exam, her picture was snapped for a cover on the Alumni News. She was so excited that she failed to pass the exam.

As a first term sophomore in the summer of '43 Miki tried out for the CORNELL ENGINEER, and was very proud when she was elected Managing Editor last June. She has also been House President of her sorority, Kappa Delta, for two terms and is jokingly dubbed "drunk with power." She also pays her dues in the ASME and enjoys the meetings ("with refreshments").

One of her best memories of Cornell and engineering was the weekend spent at Northwestern University in October, '44, to represent the CORNELL ENGINEER at a conference of the Engineering College Magazines Associated. It was her first trip to Chicago and she enjoyed the trip, the conference in Northwestern's new Engineering building, and the contacts with all sorts of interesting people.

Her advisor used to warn her about getting married before finishing her education, but she fooled him—she's going to wait until after the war. However, she has supplemented her machine courses with the marriage course during this, her last term.

Her immediate future contains plans to first graduate, then take a month's vacation ("eight terms in succession without any summer vacations have lowered my strength") and then to work. She doesn't know just yet with what concern she will be working. While waiting for her ensign to return from the Pacific, incidentally, she plans to fulfill many neglected plans, such as learning to fly, doing lots of sailing in the summer and skiing in the winter, reading many books she has missed, taking more piano lessons, and learning to cook!

Seth Heartfield, Jr., CE '45

THE icy blasts of Cayuga's waters are finally subsiding for another few months, and among those breathing a huge sigh of relief is one of our more scholarly colleagues in the Civil Engineering School, Seth W. Heartfield, Jr. Although born in New York City (in the Manhattan, not the Bronx, sorry) he stayed there for too short a time to accustom himself to our 'normal' winter weather up here, and chose instead to move to the balmy climate in Baltimore, Maryland.

After preparing at St. Paul's School in Baltimore, where he played a good game of golf on the Golf Team and took scholastic honors in his class, Cornell claimed his presence and so he came. He claims that the combination of his father being an alumnus of Cornell from way back and the fact that Cornell is considered nearly tops in the engineering field were the main factors in his choosing Cornell. But we found that he brought along a four year McMullen Regional Scholarship, and while here was awarded a McMullen War Scholarship.

Anyway, Cornell and Seth have managed to get along remarkably well ever since his arrival. At the very start the Dean's List welcomed him, has entertained him every term since, and promises to do so

(Continued on page 30)

Seth

EDITORS

Ben-Ami Lipetz, ME '47

Ben-Ami Lipetz, ME '47, has served the Cornell Engineer well as Assistant Editor. His position is that of general trouble shooter and mechanic for the magazine. To carry this out he must assign jobs, and hunt down biographies and articles. Perhaps the fact that Ben was born in the old pioneering town of Fargo, North Dakota, gave him the foresight and even temper required of his job. Despite the limitations of a wartime accelerated program, Ben has kept his eye toward improvement in efficiency and quality of this magazine.

Before coming to Cornell, Ben went to the new Bronx High School of Science. Here he received an academic foretaste of a scientific education. In high school Ben played on the soccer team, and participated in the Forum, and orchestra. He was on the Student Council for three terms, and the Senior Council, and was elected to Artista, earning an average above ninety. Ben was also editor of his school newspaper.

After high school, he worked as office-boy for some time for the American Standards Association, later quitting in order to take tests for college scholarships. Early in his high school career Ben decided to become a science journalist. He therefore chose to study engineering to acquire a knowledge of the effects of methods, applications, and standards of science and industry on our particular mode of living and on those of other nations.

Ben

Ben's reasons for coming to Cornell were twofold. He wanted a good engineering course combined with a coeducational system—both quite important to a prospective journalist. He has received three scholarships for his work here. Although his brother graduated from Cornell as an Electrical Engineer, Ben denies any parental or brotherly influence upon his choice, but he adds that he would have come to Cornell if only for the scenic beauty. He is taking a straight M.E. course, the closest to an industrial option which he could find. Although he

(Continued on page 34)

Charles Hansen, ME, V-12

"My claim to fame?" asked Chuck Hansen. "Well, our class didn't win the Bible, but one thing I like to brag about is the *Forest Park Review* baby contest which I won at the age of 4. Chances are good that the chubby little fellow in the straw hat and overalls carrying a fish-pole and a can of worms not only looked fishy, but also smelled that way because he and his cousin used to spend their summers up at a lake in northern Illinois, fishing and hunting for turtles, crabs, and frogs—even got a wild duck with an oar one time. Fell in the swamp rather often; so there must have been an odor."

There was no such thing as "drifting into engineering" for Chuck. As far back as he can remember, his folks thought he would be an engineer and since he never found the slightest reason for objecting, Chuck eventually wound up at Cornell on the long end of a McMullen scholarship, studying mechanical engineering.

Even at the risk of becoming a "jack of all trades . . .", if at all possible Hansen would like to avoid specialization in some narrow field of engineering. This may be due to the fact that none of his experiences so far have given him any

Chuck

preference for a particular lifetime job; although, together, they have taught him a few little lessons. Being a newsboy taught him to collect bills promptly; in a cedar chest factory he learned that the most important part of the job is the final varnishing; he found out in a machine shop that there is no such thing as a "putting on" tool; while as a greens-cutter on a golf course he discovered that the only golf ball which will hit you is the one with your name on it (". . . and my name isn't Po-Do," says Chuck).

The most enjoyed vacation Chuck ever had was either on a 500 mile bike trip through the southern part of Wisconsin or else at the 1937 National Boy Scout Jamboree in Washington, D. C. His favorite movie was "Fantasia." His favorite joke is not printable.

Other likes include waterfalls, hiking, "Blondie", building campfires, a checkmate, riding his motorcycle, gum, sunsets, plain people, and flank steak, carrots, peas, sweet potatoes, corn-on-the-cob, cranberries, and warm apple pie with cheese.

Dislikes: Big Noises of all kinds.

C^2 became editor-in-chief of the Cornell Engineer last June, after having served successively as compet, associate editor, and assistant editor. He believes that his work with the Engineer has helped to give him a useful panoramic view of the entire engineering field, plus a certain amount of practice in writing and a large amount of practice at meeting and avoiding people.

(Continued on page 34)

NEWS OF THE COLLEGE

Delta Club

THE following men were initiated into the Delta club at the Fraternity apartment Sunday afternoon, January 28:

Prof. Charles Sayles
Charles Stanford, USMCR
Ken Simon, USMCR
John O'Connell, USMCR
Paul Russell, USNR
G. S. Smith, USNR
Donald Ironside '46
William Richardson, USNR
Warren Newman, USNR
John Hastings, USNR
Roy Griffin '46
Thomas Madden, USNR

The initiation banquet was called off because of the fuel shortage. George Jameson was elected president, and Roy Griffin secretary-treasurer.

ASCE

AT a meeting on February 7, ASCE heard a talk given by Professor C. E. O'Rourke, concerning some of the engineering mistakes made at Pearl Harbor before the bombing, and some of his experiences there. Professor O'Rourke was in Hawaii four months before the fatal December 7, 1941.

All freshmen, sophomores, juniors and seniors were invited to the meeting which was followed by a membership drive.

AIEE

INSPECTING the Navy diesel and electrical equipment in the new Diesel lab, the AIEE held its last meeting on February 2. Five instructors showed the men around in small groups to see especially the electrical equipment.

At the last meeting on March 9, Prof. Doty of the School of Civil Engineering addressed the group on the various "Valley Authorities" hydro-electric developments.

Scholarship

ENDOWMENT of a permanent scholarship at Cornell University by Eugene Meyer, editor and publisher of The Washington Post, in memory of his brother who was lost in the sinking of the Titanic in 1912 has been announced by President Edmund E. Day. The endowment amounts to $26,400.

The bequest will become the Edgar Joseph Meyer Memorial Scholarship and may be awarded without restriction as to the course of study a student may select.

A 1905 Cornell graduate in engineering, the late Mr. Meyer and wife were aboard the Titanic on the ill-fated voyage. He helped Mrs. Meyer into a life-boat but refused to get in himself, staying aboard to help others. He assisted in the lowering of the last life-boat, and was last seen on the deck of the ship with the ship's officers and men.

Prior to his death, which occurred at the age of 28, he was associated as a partner with his brother in the investment banking business in New York City under the name of Eugene Meyer, Jr. & Co. The firm, which specialized in mining and industrial enterprise, was the first to develop in an important way a statistical and engineering department in connection with investment banking activities.

McMullen Scholarship

Winners of the new McMullen Regional Scholarships are:

District 2 (Pennsylvania)
John W. Mapoles, Johnstown, Pennsylvania
Robert P. Rhodes, Jr., Pittsburgh, Pennsylvania

District 3 (New Jersey)
Earl C. Nelson, Dover, New Jersey
Edward J. Serven, Jr., Clifton, New Jersey

District 4 (Delaware, Maryland, Virginia, District of Columbia)
Clarence E. Andrews, Baltimore, Maryland
David W. Kennedy, Baltimore, Maryland

District 5 (South Eastern States)
Earl T. Groves, Castonia, North Carolina

District 6 (Kentucky, Tennessee, West Virginia)
Lent L. Abbot, Jr., Charleston, West Virginia

District 7 (Ohio)
Edwin A. Schneider, Jr., Cuyahoga Falls, Ohio

District 8 (Indiana, Michigan)
Jack A. Snyder, Lansing, Mich.

District 9 (Illinois)
David H. Ross, Chicago, Illinois

ASME

The Cornell student branch of A.S.M.E. terminated its activities for the fall term with a meeting on February 14. Highlighting the meeting was the awarding of prizes to the winners of the speaking contest sponsored by A.S.M.E. The recipient of first prize was J. D. Kreuter whose topic was "Segregation of Coal". Second prize went to J. M. McCarthy who spoke on "Women In Industry."

First prize in the contest consisted of a Mark's Handbook and a suitably inscribed gold Cornell key, and second prize was a suitably inscribed silver Cornell key.

During the business meeting plans were made for the activities of the Student A.S.M.E. for the spring semester. Beer and potato chips were in prominence during the remainder of the meeting.

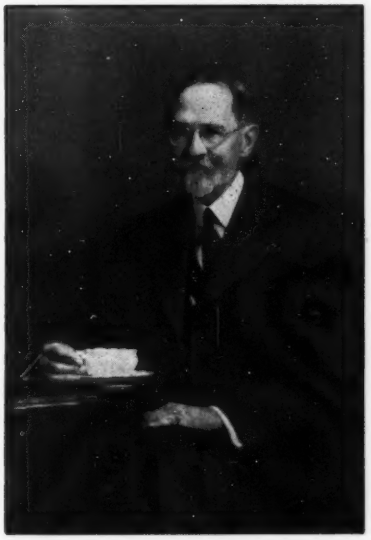
ALUMNI NEWS

MISSISSIPPI Valley Structural Steel Co., of which ROLLIN D. WOOD, C.E. '06, is president, received the Army-Navy "E" December 28 at its Maplewood plant in St. Louis. In this plant and its plants at Decatur and Melrose Park, Ill., the company fabricated for the first time in this country railway bridges and portable airplane hangars which are shipped abroad in standard units, for quick erection. Special tools, jigs, and production line procedures were developed for the close tolerances required in the standard bridge units.

ONE of the first companies to be granted a fifth renewal of the "E" production award is the Bausch & Lomb Optical Co. of Rochester. THEODORE BAUSCH DRESCHER, '18 *is vice-president of the firm. Among the other Cornellians employed there are*: CHARLES C. NITCHIE, '05, *sales engineer;* ERNEST L. BAKER, '09, *inspection;* CARL E. BAHN, '16, *engineer;* RAYMOND VANDE VATE, '17, *assistant advertising manager;* FREDERICK W. ARMBRUSTER, '18, *designer;* RAY L. BOLINAS, '25, *process engineer;* LESLIE E. CULVER, '26, *production control;* B. FRANCIS WRIGHT, '26, *inspection;* NORMAN HORN, '30, *set-up;* ROBERT D. KELLER, '30, *engineer;* KENNETH G. KUGLER, '31, *inspection;* MRS. ALFRED W. FOLSOM (ELMA SHAVER) '37, *laboratory technican;* HERBERT J. MAULT, '41, *designer; and* FRANKLIN S. REED, '41, *Safety engineer.*

SANFORD A. MOSS, '03 Ph.D., engineer for the General Electric Co. and inventor of the turbo-supercharger, received January 19 a turbo-supercharger that functioned perfectly during 102 missions over Europe. Moss received the gift from Captain W. E. O'Brien, who represented the 381st Bomber Station in England. Army Air Force mechanics said that the charger was as good as new after 1,004 hours in combat. The average life of a good turbo is about 500 hours. A congratulatory message from General H. H. Arnold was read at the ceremonies, which hailed Moss's invention as a "significant symbol of the strides we have made since you conceived the idea of supercharging engines more than two decades ago."

Reading from left to right in this picture taken in 1880, (bottom row) Oliver, Jones, Crane, Lucas, Babcock, Hewett, Law; (second row) H. W. White, Anthony, Fuertes, Shackford, A. D. White, Caldwell, Wilson; (third row) Church, Williams, Tuttle, Burbank, M. C. Tyler, Comstock; (fourth row) Corson, Perkins, Prentiss, Gage, Breneman, Osborne, Flagg, Crandall, Schaeffer, Moler, Hale.



IN the second issue of this volume, the CORNELL ENGINEER offered a moustache cup to the first person to identify fully an old, uncaptioned photograph which had been found filed under "Faculty" in the college office. The photograph, showing a group of gentlemen, decked out with toppers, derbies, whiskers, and walking sticks, was obviously taken during the last century, probably on the steps of McGraw Hall.

Many faculty members and several alumni have tried to identify the group, but only one person has submitted a complete and correct list. This gentleman is Mr. William E. Reed M.E. '89, who is shown above with his prize. Other alumni who submitted partial identifications are Hugh E. Weatherlow C.E. '06, William G. Atwood C.E. '92, Stanley W. Hayes M.E. '91, and Dr. W. F. Durand.

The faculty group photo which was the entire Cornell faculty in 1880 is herewith reprinted with full identification.

WILLIAM F. OHL, '97, *was guest of honor at a dinner given by his associates in the New York City Department of Public Works, when he retired as assistant civil engineer of the Department, January* 31, *his seventieth birthday. Known as "Kick-a-goal Ohl," he played fullback on the Varsity football team*

(Continued on page 42)

Recent Developments In Engineering

Techni-Briefs

Centrifuge

WHAT is believed to be the world's fastest merry-go-round is now helping the Air Force pilots combat superhuman forces of gravity at high speeds or in violent aerial maneuvers. Developed by the Army Air Forces Material Command the ingenious machine, called a centrifuge, enables studies of how much strain above or below the normal forces of gravity a pilot can take without losing consciousness. It is now in use at the Aero-Medical laboratory at Wright Field, Ohio.

While whirling the subject at 40 miles an hour, the machine tilts him in such a position that he is affected as if he were pulling out of a steep dive at a speed in excess of 500 mph. At the same time delicate instruments attached to him record his blood pressure, pulse, and respiration, and his reactions are tested when he returns signals flashed by an observer.

A movie camera shows that at high speeds blood drains from the subjects face, his cheeks are sunken and he looks 20 years older. As the force exerted multiplies the force of gravity, the flier sees grey at first and then blacks out completely. When the force is removed he returns to normal almost immediately.

The effects of centrifugal force on pilots was tested by the Germans as early as 1934. First experiments were performed in this country in 1936. And now that the fruit of early research has made possible the world's fastest merry-go-round, it is giving American pilots one more edge over the enemy.

A-C Gyros

SMALL panel-mounted instruments have used air-operated or a-c gyros driven from inverters, but most of the large gyros used in flight-control devices, bombsights, and similar computing devices have employed d-c motor-driven gyros. At the high speeds at which gyros operate (7500 to 20,000 rpm) brush friction can cause precision errors and brush dust is apt to foul the bearings. Direct-current gyros are usually series-wound because of the high inertia wheels and long starting time (sometimes one-half hour to reach full speed) and as a result the speed increases very considerably as air friction decreases at high altitudes.

For these reasons, a program is underway to develop a-c gyros for the more important applications. Largest of the a-c gyros is one with a rotor five inches in diameter operating at 12,000 rpm from a 400 cycle, three phase supply. This is a vital part of the automatic pilot.

Although "inside out" squirrel cage motors are used for some of these gyros, most of them are "inside out" hysteresis motors. The usual rotor is part of the flywheel and rotates outside of the air gap, the polyphase stator being wound inside of the air gap. Hysteresis motors require no squirrel cage, but instead employ discs of permanent-magnet steel for the rotor. Magnetic hysteresis caused by the rotating field causes the rotor to accelerate and finally fall into synchronism. The current drain changes very little from locked to synchoronous operation, a considerable advantage when these gyros are driven from small inverters.

Glow Lamp

A new type of glow lamp, which was developed by the Westinghouse Electric and Manufacturing Company and which is about the size of an average marble, puts out continuously more light than a quarter watt neon glow lamp, with an en-

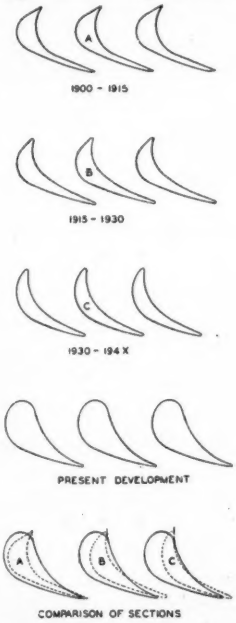
The centrifuge *—Courtesy of General Electric*

An arc-welding spotlight has been developed by General Electric to enable a welding operator to see his work clearly through the welding lens of his helmet before striking the arc. The operator can thereby strike the arc exactly where he wants it, without "pecking" or "feeling" around. Time is saved and spoilage avoided. *—Courtesy of General Electric*

ergy imput that in a year's continuous burning does not add up to one kilowatt hour. At average domestic power rates it will consume less than three cents' worth of energy in a year.

The glow lamp is actually a miniature fluorescent lamp. A discharge takes place in a rare gas, and the resulting radiation is converted by phosphors on the inner walls of the bulb into a soft green glow. A tiny resistance in the miniature screw base serves as ballast.

Held beside a neon glow lamp of the same wattage in daytime, it would be judged of equal brightness. The green light emitted by this lamp, however, falls in the region of night sensitivity of the eye;



EVOLUTION OF REACTION BLADE SECTIONS
—Courtesy of Westinghouse

and consequently, to eyes dark-adapted, the lamp appears four times brighter. Thus it is ideally suited as a night light for domestic use. It is possible that larger sizes, up to one watt, may be made for use as markers and indicators on panels and other industrial applications. These lamps, however, will not become available to civilians until the war's end.

Control Governor

A patent has been granted for the Simpson control governor named after the inventor, Sergeant Ernest Simpson. The device is for use on air compressor units, and its principal function is to reduce the speed of the engine when the compressor is not under load.

When attached to a small mobile unit, the idling speed of the engine can be reduced 34%, the gasoline consumption cut 15%, and the exhaust temperatures decreased 13%. On larger units the idling speed can be cut 30%, gasoline consumption cut 11.5% and exhaust temperatures decreased two per cent.

This device has an important war time function since it is expected that the Simpson control governor will greatly prolong the life of air compressor units, reduce maintenance and repairs, and save valuable cargo space that would otherwise be used to transport gasoline.

Impulse Blades

WHEN the need arises for stronger impulse blades for high-pressure steam turbines, Westinghouse designers will be ready. From the laboratory, complete with life tests, has come a new blade construction able to withstand duty much greater than present blades. In fact, to determine the strength limits of the new pinned blade, a stronger test machine had to be built.

The root of each blade is shaped like an inverted U. Three blades are brazed together forming one solid segment, which fits into circumferential grooves in the spindle. With the segments in position, holes are drilled crosswise through the rotor and through edges of two adjoining segments. Pins are then driven through these holes and the ends peened. The result is a tightly locked structure in which the areas carrying stress are positively known, something not always possible with

New pinned blade segment compared with conventional double-T blade.
—Courtesy of Westinghouse

—Courtesy of Westinghouse
The new reaction blade

multiple-fit blades.

The new construction, in addition to its great strength, has other advantages. Any segment of three blades can be removed directly without disturbing any other segment. For the same steam-working area the blade is smaller. It is 1½ inches wide by 2 inches deep as compared with 2 by 3½ inches of the present multiple-fit blade. As a general principle, the narrower the blade for a given steam port height, the greater the efficiency possible.

The blade with a double-T root is giving a good account of itself under the severest condition imposed on present-day units, but the new blade is ready for the day when greater steam loadings are imposed.

New Reaction Blade

A new reaction blade for steam turbines that permits wide variations of speed with relatively small reduction in efficiency has been developed by Westinghouse.

In sharp contrast to the blades with a relatively sharp forward edge commonly used, the new reaction blade looks in cross-section like a curved airplane wing, with its characteristic blunt leading edge. The blunt-edge blade has both an operational and several constructional advantages. The maximum efficiency obtainable is practically the same as that of blades having relatively sharper inlet edges. The blunt-edged blade, however, suffers

(Continued on page 36)

Dedicated to ye ancient and honourable society of ye chemical engineers in ye belief that Chemicale Engineering is ye one, ye only art.

"Caustic"

By JIM EDISON, ChemE, V-12

WE have pulled more than our share of boners while writing mech labs, but we really climaxed our career the other day when we submittted the last 3x40 report. We claim we were framed—it's just not in us to be that stupid—but framed or not, there on the last page of the report, instead of the concise summary we had intended, was a typewritten copy of "Seven Old Ladies". We were quite amazed at this unorthodox entry, and we have wondered since just what Professor Mackey thought when he tersely penciled "Flue gas analysis or boiler water conditioning? ? ?" in the margin.

And speaking of 3x40—we *can* speak of it, now that we're done—reminds us of a time when we went to see Professor Andrae, regarding an extension. We gave forth our reasons—watch, confined to bunk with influenza, prelims, 710 reports, press of other work—in such a mournful way that we practically had the good professor in tears as he wrote out our extension slip. It was somewhat later that we noticed what he had placed as a reason for the extension—"Job, in person." Now we went to Sunday School once, and we vaguely recalled a Biblical character name of Job. So we borrowed a Bible and looked the gent up. Seems as if he had more than his share of troubles. First a plague of boils from his head to his heels; then he lost all his vast flocks and wealth, so that his friends denounced him; and finally, his wife and family didn't recognize him. We pondered this, and began to understand the slight smile the professor gave us as we left him. We even thought about adding a little note of our own—something to the effect that Job was a piker compared to us—but we curbed the impulse, deciding to leave well enough alone, and submitted the report devoid of our scintillating wit.

* * *

This month's advertisement:—

"Loth! One front tooth by Susie Westbrook, 115 Highland. Finder pleath return immediately becauth it ith impairing her speeth."

* * *

POME

Who borrows all your ready jack?
Who smokes the last one in the pack?
  Your roommate.
Who breaks up all your chairs and lamps?
Who uses all your postage stamps?
  Your roommate.
Who drinks all your hoarded beer?
Who makes your socks just disappear?
  Your roommate.
Who takes your best girl to the show?
And smirks as he tells of it, blow by blow?
  Your roommate.
But who's a constant pal to you?
Who cheers you up when you're feeling blue?
Who knows and loves the things you do?
  Your mother.

* * *

Like our old friend Bob Simonds who created a new twist to the manpower jokes when he and his date stepped into the Dutch the other night, and he said:

"All right fellows, is it Dutch tonight, or do the girls pay for everything?"

But you really can't blame him. The town in Ohio from whence he came is so small that "Welcome" and "Come Again" are painted on the same sign.

* * *

Mother: Daughter, didn't I tell you not to let that man come to your apartment last night? It's things like that cause me to worry.

Daughter: Don't be ridiculous, mother. I went to his apartment. Now let his mother worry.

* * *

V-12 lament:

I do not mind the powder marks
You leave on my lapel.
I don't object when cherry lips
Reveal our love too well.
But, oh my sweet, I must record
In bold and sweeping letters,
My very strong antipathy
To white angora sweaters.

* * *

For the Irish (God bless 'em):

Two young Irishmen in a Canadian regiment were going into the trenches for the first time, and their captain promised $1 for every one of the enemy killed.

Pat lay down to rest while Mike watched. Pat had not lain long when he was awakened by Mike shouting: "They're comin'! They're comin'!"

"Who's comin'?" inquires Pat.

"The enemy," shouts Mike.

"How many?" questions Pat.

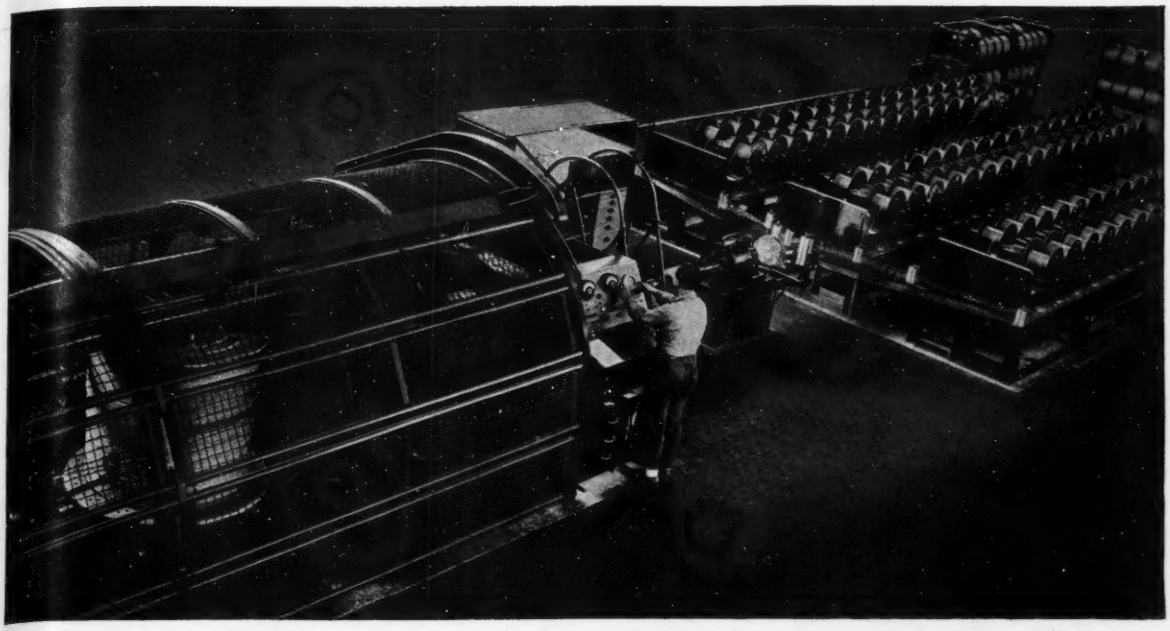
"About 50,000," sez Mike.

"Begorra," shouts Pat, jumping up and grabbing his rifle, "our fortunes made."

* * *

Infirmary doctor: I can't quite diagnose your case. I think it must be drink.

V-12: 'S all right, doc. I'll be back when you're sober.



It's SOME machine!

It's a high speed flier-strander which forms unit cores for telephone cable.

One-hundred-and-one pairs of paper pulp insulated copper wire from the supply reels are assembled and bound with cotton, then are taken into a unique revolving flier which twists them into a unit cable core—all at the rate of 600 linear feet per minute, or twice as fast as machines previously used. Several of these unit cores are later combined and sheathed in lead to make the familiar telephone cable.

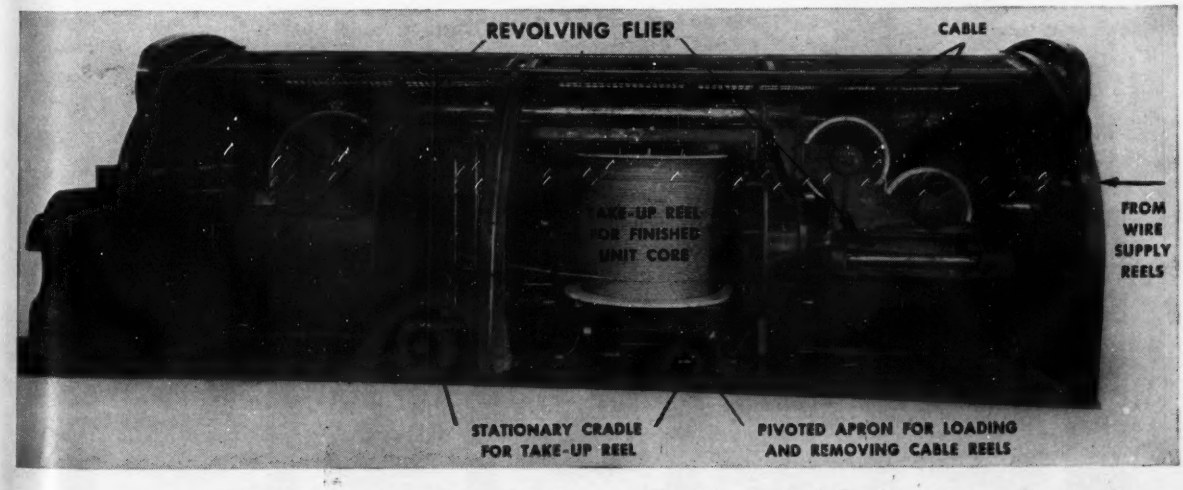
Each of the 101 supply reels holds up to eight miles of paired wire and has an individual motor drive with sensitive control to insure uniform tension on the wire.

This is but one of many interesting and unusual machines designed by Western Electric engineers to advance the art of manufacture in the field of telephone equipment.

Buy all the War Bonds you can . . . and keep them!

Western Electric

IN PEACE...SOURCE OF SUPPLY FOR THE BELL SYSTEM.
IN WAR ..ARSENAL OF COMMUNICATIONS EQUIPMENT.



HOW THE FLIER-STRANDER WORKS. The assembled and cotton-bound bundle of wires enters the machine at the right and passes into the revolving flier (shown in a lighter tone). In the flier, the wires pass over two pulleys, travel through a tube to the left end of the machine, pass around another pulley and enter the stationary cradle where the finished unit core is wound in smooth, even layers on the motor driven take-up reel. The flier revolves 200 times per minute and imparts two complete twists to the core each revolution, while an ingenious gear arrangement holds the cradle stationary within the revolving flier.

Helped Hatch 89,00 U.S.

Allis-Chalmers Mercury Arc Rectifier

THE WORLD'S BIGGEST ELECTRONIC DEVICE

made by Allis-Chalmers, speeds U.S. warplane production—holds the key to new "miracle metals" to come!

Thousands of "Big Boys" like this are in the making in U. S. aviation plants. No aluminum shortage today. Hundreds of huge electronic devices see to that!

ENGINEERING THAT AIDS ALL INDUSTRY—FURTHERS AMERICAN GOOD LIVING

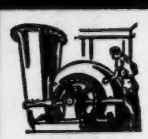
ALLIS-CHALMERS AC MILWAUKEE

ALLIS-

ELECTRICAL EQUIPMENT

STEAM AND HYDRAULIC TURBINES

MOTORS & TEXROPE V-BELT DRIVES



BLOWERS AND COMPRESSORS

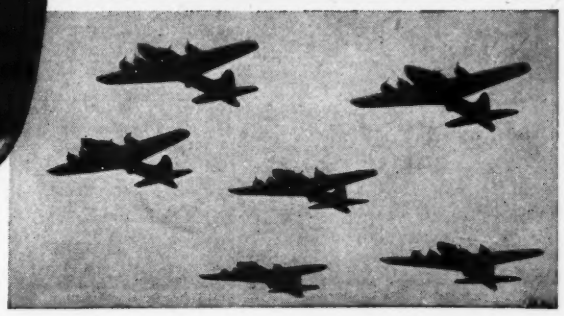
ENGINES AND CONDENSERS

CENTRIF PUMPS

...U.S. War Birds—

...livers" of aluminum, → ...agnesium, other vital ...r metals flow off U. S. ...oduction lines speeded ... Allis-Chalmers Mercury Arc Rectifiers. Big boost for U. S. airpower!

...e after Wave → ...S. warplanes now attack ...enemies—thanks to a ...tiful aluminum supply!



Amazing story of a "laboratory curiosity" that became an Industrial Giant!

ONE OF THE GREAT miracles of this war—the rapid expansion of U.S. airpower—was performed with the help of a huge electronic device—the *Allis-Chalmers Mercury Arc Rectifier!*

First introduced to America in practicable form by Allis-Chalmers, the Mercury Arc Rectifier provided—in the nick of time—a fast, easy way to convert alternating to direct current for mass production of aluminum and magnesium for warplanes.

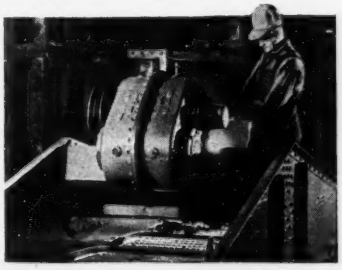
After war, the Mercury Arc Rectifier—*plus the other 1600 Allis-Chalmers products*—will help speed production of many things America needs and wants . . . will work for better peace-time living!

VICTORY NEWS

Better Pulpwood, More of It—With Less Manpower! Important help in reducing serious manpower shortages in the nation's pulp and paper industry is Allis-Chalmers' new Streambarker...a machine which removes bark from pulpwood logs quickly, thoroughly, economically by means of water under high pressure.

Streambarker does away with hand cleaning of wood, eliminates pulp loss from "brooming" of log ends, produces cleaner wood for pulp than is possible with older type barkers.

More Help for "Sink-Float" Plants: To facilitate wet screening and dewatering, Allis-Chalmers has designed a new End-Tension Deck for Low-Head Vibrating Screens.



New deck construction assures uniform depth of product and maximum use of screen surface for more efficient operation. Write for Bulletin B-6321.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TUNE IN THE BOSTON SYMPHONY—

Allis-Chalmers' coast-to-coast radio program dedicated to the men and women of American Industry!

Hear the World's Finest Music by the World's Finest Concert Orchestra with Serge Koussevitzky conducting. Over the Blue Network, every Saturday, 8:30—9:30 P.M. (E.W.T.)

FOR VICTORY
Buy United States War Bonds

...ALMERS

SUPPLYING THE WORLD'S LARGEST LINE OF MAJOR INDUSTRIAL EQUIPMENT

Cornell Society of Engineers

107 EAST 48TH STREET 1944—1945 NEW YORK 17, N. Y.

Mr. Savage

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

MUCH has been said of the stored-up purchasing power that each American family has accumulated during the current war. Extravagant predictions have been made upon the devastating effect the release of this frozen buying power will have on our supply of commodities and manufactured goods and the ability of manufacturers to meet these insatiable demands. Whether the American public goes out on a buying spree remains to be seen. My own feeling is that the average family will be sober and deliberate before making any sizeable commitment on automobiles, homes, home furnishings and equipment. They will be restrained from making purchases until they have evaluated what the "passing show" has to offer in order that the products they buy best meet their requirements and that each dollar invested brings its fullest return in comfort and happiness. The "doing without" that they have become accustomed to, due to the restrictions of war time production of needed items, may well have a continuing effect in the post-war period except for items of household necessity which must and will be replaced when such goods are available. However, in the field of education, there will be no such restraining influences. The children of families, made more comfortable by the war, supplemented by the military beneficiaries of Federal legislation will make extraordinarily heavy demands on our institutions of higher learning. Cornell will be ready for this influx but the makeup and education of the student body will present many new problems which will have to be solved. One way in which the Society of Engineers can be of tremendous value to the University is in the encouraging of the highest types of our American youth in coming to Cornell. That this is best done on the neighborhood level has been a long established fact. Cornellians should, Cornellians must make this effort in behalf of the best interests and the welfare of Cornell, if Cornell's coveted prestige among her sister universities is to be maintained.

While the membership of the Society is at an all-time peak, only a small percentage of our engineering alumni are on our membership roles. In order that the Society best serve the University in these critical times, loyal engineers should be on our membership roles, and therefore I should like to charge each of the members of the Society to obtain a new member.

The CORNELL ENGINEER is a splendid publication and through its pages we are kept fully informed on engineering developments. However, interested and loyal alumni should be equally concerned with the welfare of the entire University. In order to keep fully informed and in order to better serve, it is suggested that those of you who already are not subscribers to the Cornell Alumni News should do so at once. This publication is now owned by the University and since it is dedicated to your service, it deserves your support.

BERNARD A. SAVAGE, M.E. '25

to destroy 'em you have to see 'em

Microscopes are gunsights in Medicine's battle on bacteria.

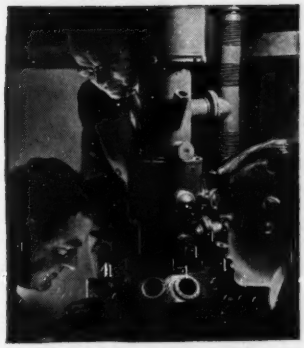
Optical microscopes, however, were not powerful enough to "draw an accurate bead" on the deadly virus that caused influenza.

But today, medical men have seen what no optical microscope could bring into focus—the infinitesimal influenza virus that previously had lain craftily camouflaged among larger cells.

This revelation came about through the Electron Microscope, developed by scientists at RCA Laboratories. And now, having been seen, influenza may be forced to unconditional surrender, saving the lives of thousands each year.

Here is but one facet of the genius shown by scientists behind RCA research . . . the "ever-onward" research that saves lives or creates a better radio with equal skill . . . the "there-when-you-need-it" research that gave super-secret equipment to the United Nations . . . the "way-ahead" research that goes into everything made by RCA.

When you buy an RCA radio or phonograph or television set or any RCA product, you get a great satisfaction . . . enjoy a unique pride of ownership in knowing that you possess the very finest instrument of its kind that science has yet achieved.



They see what human eyes have never seen before!

Drs. Arthur Vance and James Hillier, scientists at RCA Laboratories, with Mr. E. W. Engstrom, Research Director (standing), examine the RCA Electron Microscope that has useful magnification up to 100,000 diameters, revealing unseen new worlds to the eyes of man.

RADIO CORPORATION of AMERICA

PIONEERS IN PROGRESS

RCA

Pipeline

(Continued from page 11)

ations benefitte dthrough having relatively close supplies of water.

The telegraph construction gangs were organized later. Three of them were employed, one starting at Tripoli, Syria, one at Haifa working east, and one at Kirkuk working west. The first gang started actual construction on September 1, 1932, and the desert had been traversed in May, 1933. This gave us complete telegraph and telephone communication between the division headquarters and to the supply and maintenance points throughout their various jurisdictions.

At the time these operations were in progress, designs were being prepared for the pipe line and the pumping stations, and material was being placed on order. Since the pipe line experience of the world had been centered chiefly around the American oilfields, the nucleus of the crews, the foremen and welders for this work, were recruited from there. Four gangs were organized, each consisting of 25 to 35 Europeans and Americans and 250 to 1200 locally recruited men, depending upon the nature of the country traversed. The first one of these gangs started to lay the Euphrates River crossing close to where some authorities place the site of the Biblical Garden of Eden. The boys did name as such the east bank of the river and so it was known throughout the construction. A beautiful date garden, through which the pipe line is laid, is there. After traversing miles and miles of barren country and at last reaching this spot of indescribable green, it is difficult to imagine that the Garden itself could have been more beautiful.

The Work Gangs

The Euphrates crossing was finished October 5, 1932, and the gang moved to the Tigris in order to complete it also before the lateness of the season would bring the flood waters. On December 2, 1932, this gang, having finished the rivers, started at Kirkuk, laying west.

The three other gangs were organized and started, one at Tripoli and one on the east side of the Jordan. Both of these were working east. Another started 54 miles from Kirkuk, working west. Thus in December, 1932, pipe was being shipped and strung along the right-of-way. Truck convoys carrying 20 to 50 tons of pipe were leaving the railheads at regular intervals for their journey into the blue. Toward completion, these journeys were for 200 miles before the load was discharged just ahead of the welders. Clouds of dust were raised by each truck—clouds so thick that on calm days the trucks traveled from one to one and one-half miles apart. The four pipe line gangs,

The House of Representatives is shown at the right of Abbot Center in Beirut.

together with their numerous other supply and service departments, were functioning—and how they worked, those fellows! For their support and for their loyalty I wish here again to acknowledge my gratitude to them. Contrary to predictions of what would happen when the heat came, they kept the pace all through the long hot days of June, July, August, September, and on the afternoon—at 3:30 PM to be exact—of November 19, 1933, the last links were joined together in the middle of the desert—1180 miles of pipe had been welded.

I have said nothing of the pumping stations of which three are located on the leg of Kirkuk to the Euphrates, four upon the northern branch from Haditha to Tripoli, and five on the southern leg from Haditha to Haifa. They are spaced roughly from 60 to 70 miles apart. Five-hundred horse power Diesel engines direct-coupled to pumps having a capacity of 22,500 (42 gal.) barrels per day are used throughout. The line as far as Haditha was designed to handle 85,000 barrels per day and each of the legs from that point, 42,500 barrels. Each station has its ice plant, its telegraph and telephone communications, and now its radio. It has its wireless, tool houses, stores and supplies, and its modern village for the housing of its 50 to 60 engineers, labor, watchmen. Each has its individual airport for company use and they have been used by other aviators. They are complete power stations with all the operative and administrative problems of a city in miniature, and they must be as self-contained as an ocean liner. Each pumping station required the transportation of from 9,000 to 11,000 tons of material to its site and this does not include food nor men with their kits.

Many Men

During the peak of the construction, from April to November 1933, there were from 14,000 to 14,993 men on the payroll. If we consider the period from February 1933 until September 1934, there were never less than 9,000 men who had to be fed and paid each month. In what might be called the supervisory personnel, 16 nationalities were represented. From the beginning of construction up to July 1934, a total of 7,035,755 man-days of work were done. Only a combined percentage of approximately 1% of this was lost through sickness and accident. Up to January 1, 1934, only one case involving a contagious disease had developed in the construction forces. This was smallpox, confined to one individual.

Through the handling of 120,000,000 ton-miles of material and devotion to their jobs by this huge army, it was possible to start oil from Kirkuk on May 21, 1934. It arrived at Tripoli on July 14, 1934, and at Haifa on October 14, 1934.

Submarine Lines

But when oil was there at the shore of the Mediterranean, that was still not all. It had to be taken to refineries in Europe or America. The bottom of the sea, as is the case inland, has a very gentle slope.

(Continued on page 32)

Ceramics

(Continued from page 13)

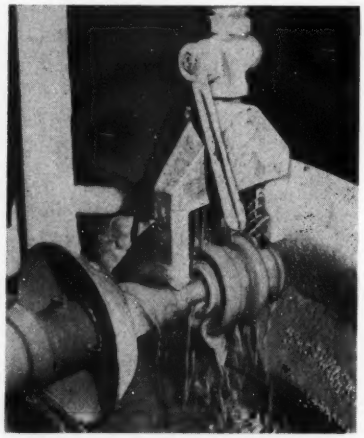
contents in addition to high temperatures. There are four types of refractories: acidic, basic, neutral, and those made of graphite.

The acidic type is made up mainly of silica combined with one or two per cent of lime or five to 10 per cent of good plastic clay. The best acidic refractories are formed by combining silica and lime very carefully. The silica grains must be angular and mixed with milk of lime so that each of the grains will be covered with a thin layer of the lime; and this mixture, when heated, forms a net-like bond which cements together the coarser grains. In order to see this bond, however, a microscope must be used. All acid refractory ware is able to combine with basic oxides at high temperatures.

Neutral refractories are those that resist the action of basic and acidic substances. Chrome brick is an example of neutral refractory ware since it is placed between magnesite and fire clay bricks in the basic open-hearth steel furnace. This type of brick (chrome) is used for repairing furnaces at a working heat which varies. The chrome brick is not affected by high temperature, but won't withstand a heavy load. Fire clay brick, however, which is the type most used in industries, is expected to stand a high temperature so it must therefore be kept free from substances which are easily fused. This is a very important precaution which is absolutely necessary to take.

Basic Refractories

Basic refractories resist the action of metallic oxides, but at high temperatures are attacked by silica. Magnesite, dolomite and limestone are the usual materials for basic refractories. Magnesite bricks are most commonly used for refractories for electric furnaces, because of their great resistance to high temperatures. However, their use is limited because they tend to chip under sudden changes of temperature, and they are apt to fail suddenly at a high temperature when under pressure. Magnesite bricks are manufactured by heating magnesite to a white heat, then calcining it. When it has cooled it is crushed and magnesite which has been calcined at a low temperature is added to serve as a binder, then mixed under high pressure and water is added. This material is molded into bricks, dried, and burned at high temperatures. Furnace bottoms are usually constructed of calcined magnesium mixed with iron ore, basic steel slag, and hot boiled tar. Also used in the manufacture of basic refractories is dolomite. The dolomite is first calcined at a high heat, mixed with tar, and again heated to very high temperatures. Limestone is also a good basic refractory except in an electric furnace, where it fuses and softens. The chief use of graphite refractories is in the form of crucibles, and they are made by adding plastic fire clay to native graphite.



Automatic coating process in the manufacture of insulators.

Chemical stoneware manufacture is a very important industry. The various shapes required must be made by skilled workmen. For different requirements different wares must be made and when finished the ware must be able to withstand all actions of acids and bases, hot or cold, except hydrofluoric acid. It mustn't break when the temperature is changed suddenly, and it must not absorb moisture. The manufacture of such stoneware is therefore an exacting task. The prevalent method for making chemical stoneware is to mix different clays with the object in mind of obtaining a product similar to porcelain. Stoneware clay is usually used, and in some instances fire clay is substituted. This is burned to approximately 155 degrees centigrade. In order to obtain the maximum in a uniform shape, the material is plunged into water and then screened so as to eliminate all coarse particles, and then the extra water is taken away by a filter press. All spigots and faucets are made from the same material as the body.

Sewer pipes are an important product of the ceramics industry. They are manufactured from stoneware clay, shale, or a mixture of fire clay and surface clay. The clay is ground and mixed, water is added, and then it is tempered. Next the clay is molded into whatever shape is desired. The material must be plastic to keep its shape and to withstand rough handling. The pipes are trimmed when they leave the press and then joined together to form elbows or junctions; then they are burned in the kiln. Just before they are taken from the kiln, several shovelfuls of common salt are thrown into the fire box, the heat liberates the sodium which combines with the silica from the clay to form a sodium silicate glaze on the surface of the pipes.

The story of ceramics is merely a story of many types of clay being subjected to many different processes and resulting in the large scale manufacture of generally inexpensive but widely applicable products.

Seth Heartfield

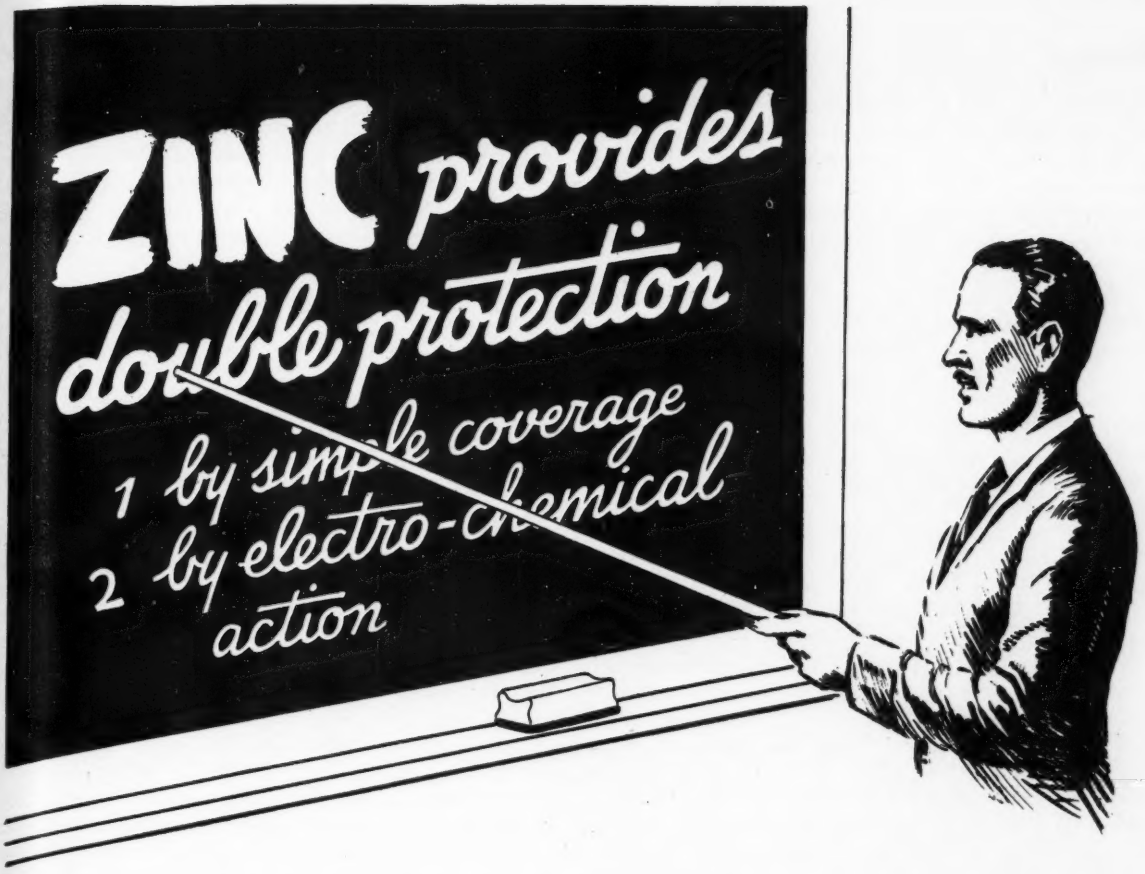
(Continued from page 16)

in the future. In addition to this noteworthy achievement, Seth was elected to Chi Epsilon, national scholastic Civil Engineering Society of which he is now secretary-treasurer, and recently was honored by initiation into Phi Kappa Phi, national honorary society.

Not satisfied with scholarly achievement alone, Seth went out for the Cornell Engineer Business Board competition and rapidly rose to the position of Treasurer and finally Business Manager, and at the present is in the peculiar quandry of holding both offices simultaneously.

Just out of curiosity, we asked Seth what he thought about the proposed five-year Engineering Curriculum and the new Engineering Campus to be built in the near future. Summed up briefly, he be-

(Continued on page 34)



Yes, zinc does double duty when applied to metals. It gives mechanical protection, with a sheath of rust-resistant metal; the durability depends on the thickness of the zinc. Zinc is also a rust inhibitor—it literally "stops rust before it starts", through electro-chemical action. The U. S. Bureau of Standards says Zinc is "by far the best" protective metallic coating for rust-proofing iron or steel.

Lifetime Galvanized Roofing

With reasonable care, galvanized (zinc-coated) roofing will last a lifetime. Its care is a simple matter—a few precautions taken at the right time is all that is necessary. These are fully described in a booklet, "How to Make Galvanized Roofing Last Longer", which will be sent free to anyone upon request. A post-card will do—send it today.

AMERICAN ZINC INSTITUTE
INCORPORATED
60 East 42nd Street • New York 17, N. Y.

Pipeline

(Continued from page 28)

One must be 5,000 feet from shore at Tripoli and 4200 feet from shore at Haifa before a water depth of 50 feet is reached. That would be too long and too expensive a channel to dredge for the purpose of bringing the huge tankers close to the oil supply at the terminal tanks, and too long a pier to build into the sea at the relatively exposed locations. Submarine lines provided the solution to the problem. Picture to yourselves two lines of welded pipe, 12 inches in diameter, side by side at right angles to the shore line. Each of them is 2800 feet long. There they lie, extending inland and lying upon the ground like two huge wire cables. A 10,000 ton ship lies off shore, but as close as possible to it, upon an especially selected calm day. One end of a wire line 2⅞ inches in diameter is brought from the ship to the shore, and fastened to an end of one of the 2800-foot pipe lengths. The steamer's path is clearly marked by buoys, and at a given signal the wire cable first becomes taut, a tremendous strain results, and at full steam ahead the steamer starts on her course dragging the pipe to sea. When the inland end is close to the shore, the steamer is halted for a couple of hours while the other length of pipe is welded to the first, and then, dragging the full 5600 feet like a huge tail behind, the ship continues its pull until the end at sea reaches its previously determined location. The entire operation of pulling the sea line has been accomplished in seven to eight hours. A diver now attaches a long length of 10-inch diameter rubber hose to the sea line. There are three such submarine berths at Tripoli and two at Haifa. Through these pipes and the 200 feet of large diameter rubber hose on the end of each, the oil is pumped from the tank farms at the terminals to the tankers anchored at each berth.

Romance In Oil

I was at Haifa when the pumps were first started at the terminal there. I could not refrain from thinking that if there is not romance in pipe lining, at least there must be in the fact that this oil from far away Kirkuk had reached the Mediterranean and had been loaded on the tanker—had been started on its way to the western refineries—by the waters of the Jordan River. The Palestine Electric Company, as you may know, has a power house on the Jordan, south of Lake Tiberias. These pumps at Haifa are driven by electric motors connected to that power house.

Official Opening

I have said that oil arrived at Haifa on October 14th. It was not until three months later, however, that I made my last flight from London to Jerusalem and Baghdad, and then on January 14, 1933 I was again in Kirkuk when the King of Iraq officially opened the valve, thereby dedicating the finish of what has been called the "eighth wonder of the world." But it was not of that that many of *us* were thinking. We were thinking of five years before, of our first trip across an unknown desert, of the nights when we camped under those brilliant skies, and when at that time difficulties darker than death or night seemed ahead. We had endeavored, we had gone on, and now hope had at last created the thing it contemplated.

Seth Heartfield

(Continued from page 30)

lieves that the combination of the two should make for some interesting changes which he would like to see and enjoy.

We were kind of stumped, so to say, when we posed the natural question concerning those private little enterprises that people have and don't talk much about—namely, hobbies. Well, to make a long story short, when he replied, "Philately" (in quotes because we want to play safe), we quickly veered to another subject channel where we could show more of our little knowledge. We thought more of the one, however, that he didn't think was worthy of mention. This embraced the novel pastime of locating radio stations by dial number, call numbers, and geographical position (also includes listening to the programs). So if any one would like quick information on what programs to find and where or when, his man is Seth.

Our curiosity could hold no longer, and so we asked the next and our last logical question (after that we beat it) as to what his plans were for the beginning of his 'free' life after June. His first answer, "sleep", rather left us up in the air, until, noting the look of utter consternation on our part, he very obligingly added that, after he awoke, he planned to get an engineering job in Baltimore.

Chuck Hansen

(Continued from page 17)

During his Freshman civilian days at Cornell, Chuck was initiated into the Phi Delta Theta fraternity. Since coming to Cornell, he has also become a member of Mesne, A.S.M.E., Phi Kappa Phi, Atmos, and Tau Beta Pi.

As far as the Navy is concerned, after graduation Chuck would prefer either submarines, landing craft, or C.B.'s. After the Navy, if he still is not white-haired, C^2 would like to spend a term at some small midwestern liberal arts college, chewing gum and thinking. Then he wants to team up with a good photographer, buy a station wagon, and go rambling over the Western Hemisphere writing articles for profit or fun about new factories and new developments in engineering.

Ben Lipetz

(Continued from page 17)

believes journalism can be picked up by experience such as he has found working on the CORNELL ENGINEER, Ben realizes the worth of a solid educational background in Mechanical Engineering for industrial journalism.

Among his many hobbies, Ben's specialities are his stamp collection, particularly Philippine stamps, and the mandolin. He also has made a collection of camping and school songs. In his second and third terms he was on the Willard Straight music committee. He likes both jazz and classical music. Ben's favorite mental gymnastic is observing people in the Straight and analyzing their future actions. His greatest ordeal, he says, is speech-making, especially extemporaneous speaking for a persuasive purpose. Ben likes to do things on the spur of the moment. One of his specialties is eating unusual foods in foreign restaurants. A favorite dish is shish-kebab, if you can pronounce it, which is spitted lamb, roasted with vegetables over a charcoal fire.

(Continued on page 44)

Techni-Briefs

(Continued from page 21)

much smaller depreciation of efficiency for off-peak relationship of blade and steam speeds. While not so important in central-station turbines, this is desirable in marine and and some industrial service where variable-speed turbines are used.

Because the blade is of heavier section, more area is available for the shroud fastening. This makes possible the use of rivets instead of welding, which is preferable for shroud fastenings because of fewer heat-imposed stresses. Machine riveting is both fast and absolutely repetitive in results. The blunt-edge blade, being thicker, has a higher natural period of vibration and is three times stronger than the thinner blade sections for the same blade width. The blade for the same duty may be narrower, which means more rows of blades in a given length, or a turbine of smaller dimensions for a given rating—again important where space is crowded as on shipboard.

New Trolley Coach

THE trolley coach, newest of all city transit vehicles and the one growing most rapidly in popularity, is undergoing many improvements in its control and drive. A new control, developed by Westing-

(Continued on page 44)

Experiment in Instruction

(Continued from page 15)

has suffered from many cases of stripped threads and twisted-off cap screws.

Among the topics covered in the lecture-discussion periods were the following: Hand Tools; Cylinder Heads; Cylinder Blocks; Piston, Ring and Rod Assemblies; Valve Types and Treatment; Camshafts; Crankshafts, Engine Forces, Firing Orders and Timing Diagrams; Engine Lubricating Systems; Engine Cooling Systems; Bearings; Piston Design; Piston Ring Design; Valve Timing Practice; Manifolds; Carburetion; Carburetor Types; Ignition and Ignition Systems; Generators; Electric Starters; Exhaust Systems; Engine Characteristics. During the lectures the engine components upon which the students were actually working were used as illustrative examples as much as was feasible. This fact contributed to student interest, since each man was particularly concerned with one engine, and also served to acquaint all of the students more thoroughly with the different types of engines represented on the floor. Questions from the group and discussions within the group were encouraged since they frequently uncovered a lack of understanding on some important point, or brought out a new method of approach to some difficult subject. With a group of limited size and of definite interest this system worked out quite well.

The actual engine work was laid out and carried through with the intention of making the students do as much of their own work as possible. Not more than two men were assigned to an engine, since experience with previous courses of this type had shown that in larger groups the energetic man did most of the work and got the most benefit from the course. The less energetic men simply rode along on his efforts and got little personal benefit from them. Space limitations indicated that eight engines could be handled conveniently, thus setting the maximum registration at six-

(Continued on page 38)

Experiment In Instruction

(Continued from page 36)

teen students. This number also proved to be all that one instructor could handle efficiently. The class was split into eight groups of two men each, and each group was assigned an engine, a set of tools, and a working space. It was their responsibility to maintain their tools and working area in good order and to study thoroughly the information revealed by their engine during its disassembly and subsequent reassembly. The instructor was available at all times for consultation, but the students were encouraged to use the engineering training to which they had been subjected and work out their own solutions to the problems encountered.

The engines were to be completely disassembled, the component parts studied and their relations and functions observed, and all units to be returned to good operating condition when feasible. The engines were then to be reassembled, made to operate in the proper manner, and if time was available subjected to a block test to determine their operating characteristics. For this purpose a rudimentary dynamometer test stand was constructed in the laboratory and equipped to handle the different engines used in the course.

Results

Up to the present the course has run through two full terms. Certain modifications of the original plans have been necessary but on the whole it has carried on much as originally expected. It was found desirable to fortify the lectures with occasional quizzes to encourage better lecture notes and to provide some help in estimating a final grade for the course. In addition, each group was required to make out and turn in a complete lubrication diagram and a spiral timing diagram for their engine. Since each engine was different in some respects from all of the others mistakes in timing or assembly were easily checked and rectified.

The requirement that every engine should be made to run and run well produced a healthy rivalry between groups.

Undue haste in assembly in an attempt to be the first to operate was the downfall of many a group. The sudden discovery during the final frenzy of assembly that they had neglected to put in the valve tappets punctured the pride of many a boastful group. The refusal of an engine to produce oil pressure in the lubricating system due to a missing oil pump brought on the good-natured derision of the other groups. So far every engine has been put back into running shape, although not sufficient time has been available to run a block test on more than a few.

It was not the intention of the course to train engine mechanics and certainly none of those taking the course would qualify as mechanics on the basis of their experience in this course alone. They have received a conception of the design, construction, operation, and maintenance of an engine which it is impossible to get in the ordinary textbook course. A course of this type cannot because of time limitations replace the common recitation course, but a carefully coordinated combination of the two could produce a student with a much better knowledge of engine fundamentals than has been possible in the past.

Training Programs

(Continued from page 8)

typer, electromatic typewriter, mimeograph machine, and the usual other office equipment. The Ozalid machine is useful in making copies of drawings. The varityper, with its many sizes and styles of type faces, is used for captions, running heads, and other copy. The electromatic typewriter with the carbon ribbon attachment insures clear cut master copy with uniform impression. Fototype is used for title pages or in other places where a large type size is needed. Illustrations are made more effective through the use of Craftint overlay. Photostat prints are frequently used when it is necessary to change the size of an illustration.

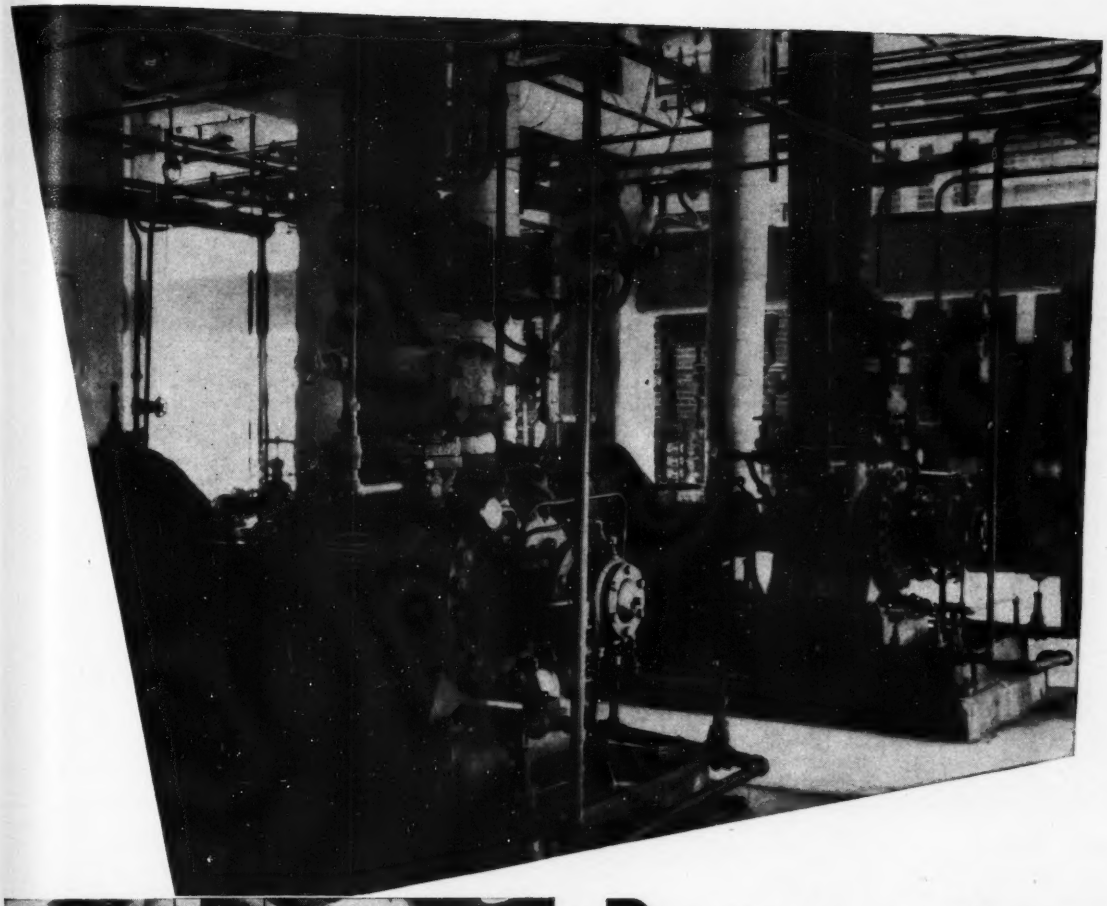
Cooperation

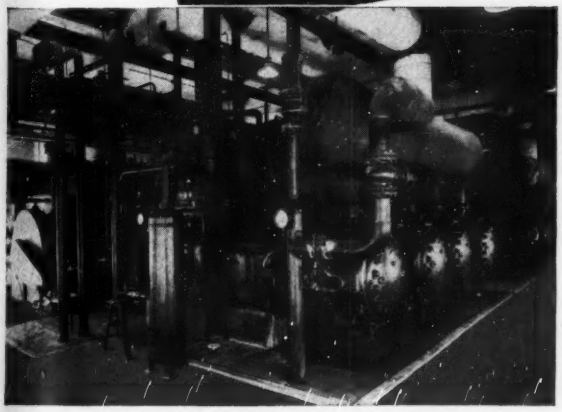
The preparation of the many and varied monographs, twenty-six to date, has been made possible through the active cooperation of many different industries. Qualified technical personnel has been made available, on a part-time basis, from many corporations. Scores of industries provided catalogs, drawings, photographs and other assistance. Without this close cooperation of industry in providing up-to-date information, and in assisting in the writing and editing of the material, the development of these monographs could not have been accomplished.

Widely Used

The monographs have gone to the far corners of the world for use in the training of civilian war workers and military personnel. Some find their greatest place of usefulness in pre-employment training programs; others are most frequently used in evening classes for the upgrading of employed workers.

The Laboratory is operated by the New York State Education Department, in cooperation with Cornell University, as a part of the war training program, under the direction of Oakley Furney, Assistant Commissioner for Vocational Education. Through the cooperation of Dean Hollister of the College of Engineering, Cornell has contributed much to the program by providing the necessary housing, library facilities and other services.





Altogether 24 Clark Compressors, totaling 15,600 B.H.P., service the Cities Service 100-Octane and Butadiene Plant at Lake Charles, Louisiana. They are grouped to function in four different processes; namely, Catalytic Cracking, Alkylation, Butadiene and De-Asphalting.

The Lake Charles Plant constitutes one of the very largest sources for 100-Octane Gas and Butadiene.

Pacifics on the job at Lake Charles

TYPE "OV" Pacific centrifugal pumps are used on the depropanizer feed at Cities Service Refining Corporation's giant 100-octane plant, Lake Charles, Louisiana.

Designed specifically for oil refinery service involving high temperatures, "OV" pumps are available in 2", 3", 4" and 6" sizes. Capacities from 100 G.P.M. to 1,500 G.P.M. Speeds up to 3,600 R.P.M. Differential pressures up to 275 pounds per stage.

Type "OV" is just one of the many Pacific Pumps designed for a specific job. See "The Refinery Catalog" for the full line of Pacific *engineered* pumps.

PACIFIC PUMPS, INC.
HUNTINGTON PARK, CALIFORNIA

CLARK BROS. CO., INC.
OLEAN, NEW YORK

"Two of the Dresser Industries"

Alumni News

(Continued from page 19)

of 1893 *with General* JOSEPH W. BEACHAM, '97, *later Commandant of the Cornell ROTC, and* GLENN S. WARNER, '94, *who has become a famous coach.*

ON January 1, LEON C. WELCH, M.E. '06, became general manager of the lubricating and sales technical service departments of Standard Oil Co. of Indiana. He joined the company through a former subsidiary, the Midwest Refining Co., in 1922. He was appointed manager of the lubricating department in 1925, assistant general manager in 1934, and elected to the board of directors last May.

AT the annual meeting of the American Society of Civil Engineers on January 17, *Maj. General* CHARLES PHILIP CROSS, '10, *Chief of Transportation, was awarded Honorary Membership in ASCE. Gen. Cross is in charge of all transport (except air) for the U. S. Army throughout the world.*

ON Tuesday, January 17, a dinner was held in New York City for past, present and incoming officers of ASCE. Those present with Cornell affiliations were:

D. W. Head '84, Past-President and Honorary Member
E. B. Whitman '01, Past-President
C. P. Cross, Maj. Gen. '10, Honorary Member
J. D. Justin '06
G. J. Rerquardt '09
J. C. Hoyt '97
N. W. Dougherty '14
S. B. Lilly '10
F. C. Tolles '05
W. M. Wilson MME '04
H. T. Critchlow '10
C. H. Canfield '10
A. W. Harrington '09
L. F. Bellinger '87
R. P. Davis M.C.E. '13, Ph.D. '14
Dean S. C. Hollister

WALTER L. CHEWNING, JR., *USNR, '36 BS in AE, has been awarded the Navy and Marine Corps Medal and promoted to lieutenant commander for his heroic action in boarding a flaming Grumann Hellcat to extricate Ensign Byron Johnson of Potter, Neb., from the cockpit. Ensign Johnson had been stunned after his plane crash-landed on the USS Enterprise. The plane's tailhook caught a wire on a waveoff after a bad approach and the belly tank ruptured and burst into flames when it nosed into the catwalk.*

COLONEL WILLIAM N. LEAF, C.E. '26, of the Army Engineers has been awarded the Bronze Star "for the performance of outstanding heroic or meritorious achievements during actual combat against an armed enemy of the United States." Colonel Leaf is now stationed in the Philippines after eighteen months in New Guinea.

ON January 9, a testimonial dinner was tendered to HOWARD L. ALLER, *M.E. '06, in recognition of his decade as president of American Power & Light Co. The dinner, at the University Club in New York City, was given by several of the directors and counsel of the company.*

HAROLD W. SIEBERT, M.E. '14, has been promoted to lieutenant colonel at Headquarters, Air Technical Service Command, Wright Field, Dayton, Ohio. He is chief of the compressibility unit, which he formed in 1943 in the aircraft laboratory. Before he was called to active duty in 1942, he was professor of mathematics and aeronautical engineering for twenty years at the University of Cincinnati.

Keeping Navy searchlight reflectors spotlessly clean is an unending job. The Haynes Stellite alloy, from which many reflectors are made, is so hard that constant cleaning and polishing will not mar its surface.

LIGHT ON THE RISING SUN

UNCLE SAM'S NAVY has the most efficient searchlights on the Seven Seas. They are so powerful that one of them measuring 24 inches across can shoot a beam of light through 23 miles of inky darkness.

The reflectors of these searchlights are made of an alloy perfected and produced by HAYNES STELLITE COMPANY, a Unit of UCC.

The Navy is using this Haynes Stellite alloy for several reasons. It will not shatter from shock of gunfire. It has high resistance to corrosion by salt air, salt spray, powder and sulfur fumes. It withstands the terrific heat of the arc light—and hot particles of copper and carbon from the electrodes do not cause it to pit and lose its reflectivity. Searchlight reflectors are indicative of the many applications to which Haynes Stellite alloys—with their unique combinations of properties—can bring more efficient performance.

Haynes Stellite alloys have long been used for scientific mirrors, surgical and dental instruments and other equipment requiring great resistance to corrosion, wear and heat. Unending research by UCC is constantly adding to the variety of these alloys. They can be produced in many exacting shapes—in quantity—and delivered ready for assembly without further finishing.

Consulting engineers, production managers, educators and designers are invited to send for booklet P-3 describing the properties of Haynes Stellite alloys.

BUY UNITED STATES WAR BONDS AND STAMPS

UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC **New York 17, N. Y.**

Principal Units in the United States and their Products

ALLOYS AND METALS—Electro Metallurgical Company, Haynes Stellite Company, Kemet Laboratories Company, Inc., United States Vanadium Corporation
CHEMICALS—Carbide and Carbon Chemicals Corporation **PLASTICS**—Bakelite Corporation **ELECTRODES, CARBONS & BATTERIES**—National Carbon Company, Inc.
INDUSTRIAL GASES AND CARBIDE—The Linde Air Products Company, The Oxweld Railroad Service Company, The Prest-O-Lite Company, Inc.

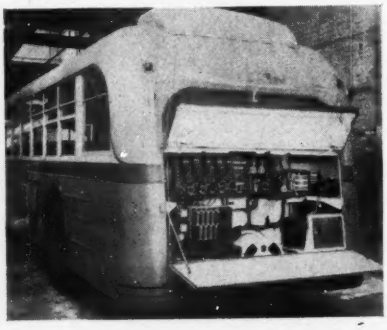
Techni-Briefs

(Continued from page 36)

house gives better performance as viewed either by the rider or operator.

Heretofore the coach operator, in the front of the vehicle, controlled the master switch, accelerator, and reverser, which are in the back of the coach, by three long mechanical linkages. These were subject to wear and possible mis-operation. Now the controls are all operated electrically. All 12-volt instead of 600-volt control circuits are used. This means the control coils are wound with heavy and more rugged wire and the space factor is increased by the lighter insulation. Cam switches replace the more complex and less positive interlocked sequence switches. Dynamic braking has been extended down to about two miles per hour from about four, with consequent less wear of the mechanical brakes.

Trolley-coach motors have been self-ventilated by a fan on the shaft. Because the speed of the motor fan varies from zero to high speed, the motor receives no cooling effect at standstill, only a little while the coach is pulling up a heavy grade, and more at high speed than is necessary, which is a power waste. The new trolley-coach motor has no fan of its own. The



—Courtesy of Westinghouse

The ventilated motor unit of a trolley coach.

separate motor-driven fan used to ventilate the resistors and control has been made a little bigger. It blows a draft of air first through the motor, then across the resistors, and in winter, into the coach for heating. Previously the motor heat was thrown away. As a result of this change, power is saved, the coach is more uniformly heated, and the motor runs cooler, which means longer insulation life.

Ben Lipetz

(Continued from page 34)

Ben is chronically reflective, is not easily angered.

His one criticism of Cornell is that more student activities should promote the mixing and interchange of ideas in order to increase college unity. Ben's major extra-curricular activity has been the CORNELL ENGINEER which he frankly admits has been more interesting than several of his classes. His hope and aim is that the ENGINEER reaches the stage where it will become the voice of the student engineers and will combine college gossip and news with good humor to unite the students and increase their interest in the educational material presented in the magazine. Ben realizes that, after it has achieved such success on campus, the ENGINEER can become a country-wide textbook for engineers like the Sibley Journal in its early days. He has virtually radiated this aim to his fellow members and, through his work and support, has helped to correct faults and improve the quality of the CORNELL ENGINEER.

THE CORNELL ENGINEER

MANAGING EDITOR
Marguerite E. Haven, ME '45

EDITOR-IN-CHIEF
Charles C. Hansen, V-12

BUSINESS MANAGER
Seth W. Heartfield, Jr., CE '45

PUBLICATION BOARD

ASSISTANT EDITOR
Ben-Ami Lipetz, ME '47

CIRCULATION MANGER
Joseph Nemeth, ME '47

ASSOCIATE EDITORS
Adam Paul Friederich, CE '46
Richard E. Goll, V-12

ASS'T CIRCULATION MANAGER
Diana L. Lembo, Ag '46

ILLUSTRATIONS EDITOR
Philip E. Silberberg, CE '48

ADVERTISING MANAGER
Melvin Goldfarb, ME '45

EDITORIAL BOARD

L. R. Anderson, V-12
R. I. Brooker, ME '48
B. P. Carter, ChemE '48
J. E. Edison, V-12
H. S. Meltzer, CE '46
A. S. Rugare, ME '47
D. B. Silver, EE '47
L. W. Simmons, V-12

BUSINESS BOARD

R. Erskine, ME '47
C. Fischer, Arts '47
R. Mann, CE '47
R. Owaroff, ME '47

We Add Our Views . . . . .

ON MILITARY TRAINING

AT the age of eighteen, a year of a person's life is a long and important period; it is much more significant than a year at the age of fifty because in youth the average person absorbs knowledge most readily. Consequently, we should be very cautious in setting up such compulsory, universal military training programs as are now proposed in Congressional bills.

Writing in the February, 1945, *Readers Digest*, T. M. Johnson says, "Until we see what happens to the world and to our plans for future peace, let us give it (compulsory training) a fair trial. Then, if we don't need it or like it, we can drop it." If that is the case, if we are not sure at all that the plan is workable, let us make certain we are right before adopting any purely military plan at all.

Having millions of men already trained as a result of this war, there is little need to worry about the present supply of trained combatants; rather, consider the situation ten years from now: by that time, the military power of our present enemies will have been destroyed so we will not need a massive army; but we never again want to require mobilization of our entire human resources for participation in a bloody tooth and nail fight for existence; this requires some type of absolute protection from war.

One thing we could use is a modern, mechanized, scientific air, sea, and land force of less than two million men. It would be an alert, fit, and well paid force, designed either to crush agressors before they can get powerful or to meet a surprize attack from a foreign power. Neither of these purposes could be well served by a slowly mobilizing, citizen's army.

It is true that the proposed universal military training program would improve general health, teach tolerance, form habits of self-discipline, and make lifetime friends; but a semi-military system, on the order of the V-12 program, would have all of these advantages, besides raising the cultural level of the country and giving educational opportunities to those who are financially poor. It would also serve as a reservoir to provide the standing army with a steady stream of good officers.

A year of college or trade school, at government expense, could be followed by the awarding of scholarships or attractive military careers to those who prove qualified. First, examinations could be arranged to determine who is fit for higher learning and who is best suited for a trade. Colleges and schools in all sections of the country could be adjusted to accommodate our entire populattion of eighteen year old youths. They could be quartered together, given rudimentary military training, and be controlled through a largely self-governing discipline system. The entire group could be physically, mentally, and morally classified; and steps could be taken to correct any defects. By giving more opportunities to those having exceptional abilities, we could decrease the number of unrecognized geniuses who must spend their lives digging ditches or filling ledgers in order to eat.

By offering military careers to men in the colleges and men in the trade schools, we could probably recruit enough officers and men to maintain the required professional fighting force. Using such a system, we could obtain protection from war without removing a year from the education of every man in these times when the desired amount of schooling increases with each scientific development.

—C.C.H.

STRESS and STRAIN...

Doctor: Any intestinal trouble?

V-12: I dunno. It ain't been issued to me yet.

Doctor: Don't you know the King's English?

V-12: Is he?

Doctor: My Gawd, but you're stupid.

V-12: That ain't nothin'. You ought to see my brother. He walks all humped over.

* * *

And then there was the frosh engineer that thought a slide rule is a regulation pertaining to baseball.

* * *

An unobtrusive gentleman in the museum was gazing rapturously at a huge oil painting of a shapely girl dressed only in a few strategically arranged leaves. The title of the picture was "Spring." Suddenly the voice of his wife snapped, "Well, what are you waiting for—Autumn?"

* * *

Found on Freshman's registration card: Name of parents: Mama and Papa.

* * *

"What kind of an officer does your uniform signify?" queried an inquisitive lady.

"Why I'm a Naval surgeon," replied the officer.

"Goodness," wheezed the lady, "how you doctors do specialize these days."

She: My dad takes things apart to see why they won't go.

He: So what?

She: You'd better go.

* * *

"That's a pretty dress you have on."

"Yes, I only wear it to teas."

"Whom?"

* * *

Kid Brother: Give me a nickel or I'll tell Dad that you held hands with my sister.

Burt: Here you are.

K.B.: Give me a quarter or I'll tell him you kissed her.

Burt: Here, pest!

K.B.: Now give me five dollars!

* * *

He: How many drinks does it take to make you dizzy.

She: Two, and don't call me Dizzy.

* * *

Kae: "I had a date with a general last night."

Jean: "Major General?"

Kae: "Not yet."

* * *

She was only a redcoat's daughter but she sure knew Howe.

* * *

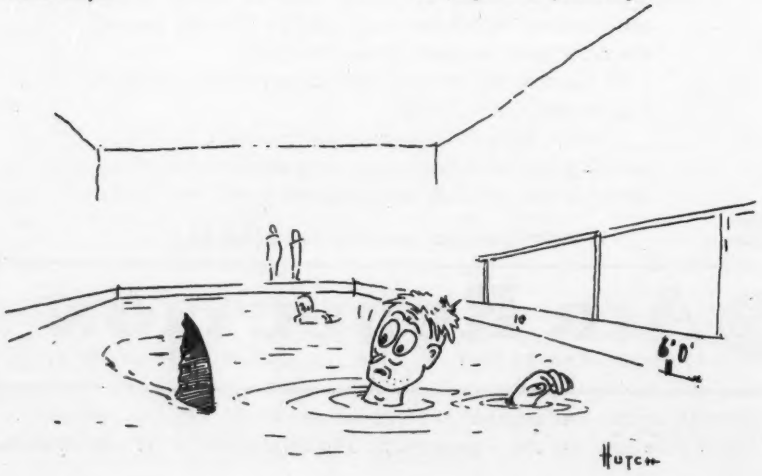
He: May I take you home?

She: Sure, where do you live?

* * *

A pessimist thinks all women are immoral.

An optimist just hopes so.



She: Do you know what they're saying about me?

Engineer: Why do you suppose I came over to see you!

* * *

The doctor and his wife were walking down the street one day when an attractive blond nodded to him. Suspicious, the wife asked, "Who is that woman, Dear?"

"Oh! only a woman I met once or twice professionally."

"Whose profession?" asked the wife.

* * *

A C.E. was walking down the street wheeling two bicycles, when he met his pal.

"Where did you get the two bikes?"

"My girl and I went out for a ride," said the C.E., "and we stopped under a tree to rest. After a while I kissed her. 'That's nice,' she said. Then I put my arms around her waist and asked her how that was. 'Great,' she said. So I kissed her cheek and winked at her and she said, 'Oh boy, you can have anything I've got.' So I took her bike."

* * *

Dave Felbeck calls his girl cast iron because she yields right from the start.

* * *

Danzer and Blitzer were tired of life in the forest and headed for the city. On the way they met a young doe, and, in answer to her query told her that they were going to the city to make some dough. "Well," she said, "I'd like to go along—I wouldn't mind making a couple of bucks myself."

* * *

The president of a large industrial plant recently married his secretary who was at least a generation younger than he. The marriage was given adequate space in one of the city's largest papers. But somehow the make-up man went haywire for the story appeared under the following headline:

"Old Power Plant Resumes Operation."